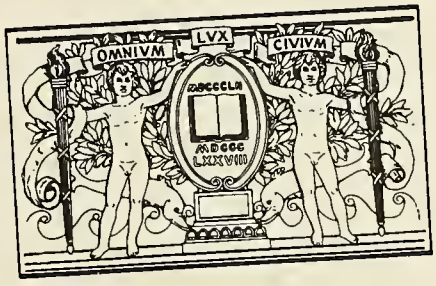
BOSTON PUBLIC LIBRARY
3 9999 06354 449 6
GOVDOC
BRA
H003



BOSTON PUBLIC LIBRARY

GOVDOC
BRA
4003

Gov. Bl. 845

CENTRAL ARTERY FEASIBILITY STUDY

TECHNICAL MEMOS

BOSTON REDEVELOPMENT AUTHORITY
Property of
Library

AUTHOR	TITLE	DATE
Herbert Benson, F. R. Harris, Inc.	Impact of Long 4 Percent Grade	March 12, 1974
Herbert Benson, F. R. Harris, Inc.	Total Removal of Elevated Structure vs. Staged Construction	March 12, 1974
Herbert Benson, F. R. Harris, Inc.	Venting of Decked-Over Depression	March 13, 1974
Edwin Colby, Boston Redevelopment Authority	Aided Ramps	March 13, 1974
Cambridge Acoustical Associates	Preliminary Traffic Noise Predictions for Central Artery Alternates	March 13, 1974
Cambridge Acoustical Associates	Preliminary L_{10} Predictions for Central Artery Alternates (see memo dated 13 March 1974 for L_{50} predictions)	March 19, 1974
Edwin Colby Boston Redevelopment Authority	Traffic Usage Central Artery Southeast Expressway Ramps	April 9, 1974
Richard McAllister Boston Redevelopment Authority	Central Artery Comparison of High Level vs. Low Level Profiles - North Street to Charles River	April 1, 1974
James Brennan Community Liaison & Technical Assistance	Review of I-93/Mystic Bridge/ Central Artery Connections in Charlestown Proposed by Bill Lamb of the Sierra Club	June 7, 1974
Herbert Benson F. R. Harris, Inc.	9-page Report of Ventilation Requirements for Central Artery	June 20, 1974
Edward Bailey Boston Redevelopment Authority	Rail Connection	July 1, 1974

AUTHOR	TITLE	DATE
Wallace, Floyd Ellenzweig	Technical Memo #12 Relationship of Depressed Artery to North Terminal Proposals	July 1974
Audrey McAllister Boston Redevelopment Authority	Technical Memo #13 History of the Central Artery	July 9, 1974
Community Liaison & Technical Assistance	Technical Assistance Primer #1 A Quick Review of Historic Preservation and Environmental Laws Affecting Transportation Projects Funded with Federal Assistance	-----
James Brennan Community Liaison & Technical Assistance	Cross-Boston Tunnel, Proposed by Arthur Hall	July 17, 1974

Attached is an article "Environmental issues in European Transportation" which is an overview on the state-of-the-art in transportation planning.

HARRIS

#1

PRELIMINARY
SUBJECT TO STUDY & REVISION

12 March, 1974

H. Benson

CENTRAL ARTERY DEPRESSION

IMPACT OF LONG 4 PERCENT GRADE

BOSTON REDEVELOPMENT AUTHORITY
Property Of
Library

The proposed below-grade depression of the Central Artery and its connection with the present elevated section of the Artery over the Charles River results in a new northbound roadway with a 4 percent grade starting in the vicinity of North Street and continuing northerly through the North End for some 2,800 feet.

The traffic carrying capacity of such a long 4 percent grade will be reduced about 40 percent as a result of the congestion due to the de-escalating speeds of all heavy trucks using the facility. Our estimates indicate that truck traffic, operating under favorable conditions on dry pavement and entering the 4 percent grade at 40 MPH, will suffer a speed loss of 15 MPH in the first 1,100 feet. After proceeding another 700 feet a heavy truck will have suffered another speed loss of 15 MPH resulting in an operating speed of 10 MPH after traversing 1,800 feet of the 4 percent grade. We have now reached the point where trucks, operating at 10 MPH, are causing an unstable, congested general traffic condition. This condition will persist until the truck regains the capability to accelerate or for another 1,800 feet, some 800 feet beyond the crest of the vertical curve at the north end of the 4 percent grade.

The only way to alleviate the undesirable congestion resulting from slow truck traffic is to provide a truck climbing lane. Since the climbing lane must be some 3,600 feet in length to be effective, and since the climbing lane must terminate some 800 feet beyond the crest of the present viaduct vertical curve, it would become necessary to reconstruct some 800 feet of the existing viaduct over the Charles River. This portion of reconstruction for a climbing lane addition falls beyond the point of tie-in attainable if the climbing lane were not added. At this point in the study, it appears unlikely that a climbing lane could be added without infringing on the Stop & Shop buildings.

Whether or not a truck climbing lane is included in the plans, it is still a fact that the truck noise level will increase from what is presently encountered as a result of the existing 4 percent grade being lengthened from 1,400 feet to approximately 2,800 feet. The large tractor-trailer truck must go through a number of gear reductions in order to negotiate such a long 4 percent grade with the resultant exhaust stack noises being produced with each gear change as you traverse the North End. The estimated noise level and the decibel contour developed will be a subject covered by others.

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

JECT

HARRIS

#2

PRELIMINARY
SUBJECT TO STUDY & REVISION

12 Mar. 74

H. Benson

Central Artery Depression

Total Removal of Elevated Structure vs Staged Construction

The original BTPR scheme of staged construction whereby portions of the existing Central Artery would continue to be used while excavation for the new depressed facility took place adjacent thereto, was a viable scheme based on knowledge available at the time of the BTPR study.

Based on added data that has surfaced as a result of our current study and our more in-depth look at actual construction conditions, we now feel we can improve on the BTPR scheme.

Our present investigation shows that the existing Artery is supported on piles with many of the peripheral piles being battered at 1:4 vertical and in some cases 1:3 vertical. The piles penetrate old harbor muds and Boston blue clays. The water table in the proposed excavation area is very close to the existing street surface and is constantly being charged by the nearby ocean.

The original BTPR scheme provided for opening up excavations fairly close to the present Artery which, in the light of our latest findings, would require extensive tie-back systems of sheetpile walls and massive recharging of ground water in the

area of Artery pile foundations. To maintain the safety and integrity of the present elevated Artery and permit continued use by traffic, it is our present opinion, based on existing available data, that we must not introduce a 'sheetpile' wall and start excavation any closer than 75 feet from the present Artery pile footings. While the proximity of excavation to the battered piles of the Artery foundations is of concern, our main problem is the resultant effect of driving a sheetpile wall down into the water table between the recharging supply from the ocean and the piles proper. It is anticipated that the sheetpile wall will act as a water cut-off inducing a draw-down curve which will materially lower the water table in the area of the Artery pile foundations. The next occurance would be the drying and subsidence of the clay layers supporting the Artery piles. The ultimate condition could be the settlement of the Artery itself. Should this occur in a differential manner, the Artery superstructure might be subjected to stresses that would render it unsafe.

To preclude the need for taking extreme measures to prevent the possible development of unsafe Artery conditions, we now propose that all traffic on the present elevated Artery (from the Dewey Square tunnel to Traverse Street) be diverted from the Artery to a surface street pattern adjacent to the present Artery. This approach would permit the smooth, uninterrupted

demolition of the present Artery superstructure and would accomplish the task in less time than if a staged approach were taken as in the BTPR scheme.

We would now be in a position to undertake the relocation of all utilities in the way of the proposed depressed Artery and simultaneously proceed with the excavation of the Artery itself without the need to be concerned for the safety of adjacent viaducts. The present state of our studies indicates that while horizontal right-of-way dimensions are tight, we can construct a 6 lane depressed facility and at the same time provide for Artery traffic at street level adjacent to the proposed depression. It should not be assumed that the street level detours will be able to handle the present Artery traffic volumes even if constructed with the same number of lanes as the Artery.

It perhaps would be well to point out that our proposed scheme for removing the Artery superstructure all at one time accrues other benefits such as: permitting the demolition of the elevated structure in an expeditous, safe and less costly sequence; permitting construction of the depressed Artery in an uninhibited manner at a pace faster than that of the BTPR staged scheme with a resultant decrease in cost; and permitting the flexibility of temporary detours at points of greatest need without conflict with present Artery supporting structures.

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

JECT

HARRIS

PRELIMINARY
SUBJECT TO STUDY & REVISION

T-3

13 March 1974

H. Benson #2

CENTRAL ARTERY DEPRESSION

VENTING OF DECKED-OVER DEPRESSION

It has been proposed that the depressed Artery be decked in whole or in part to provide for joint development and neighborhood continuity.

Should the depressed Artery be completely decked over, it would be necessary to provide a total mechanical ventilation system with fresh air duct feeds, stale air exhaust ducts and vent houses. The total envelope required for such a depressed artery would have to be large enough to accomodate the roadway plus the ancillary venting features.

In the event that a partial decking is deemed advisable, a general rule-of-thumb would permit decking of approximately 800 feet of depressed Artery without mechanical venting being required. It should also be assumed that openings between decked portions should be on the order of 100 feet in length to permit movement of air into and out of the openings in the deck. To maximize the beneficial air-cleaning piston effect of traffic in the depressed Artery, it would be necessary to insure that the Artery be constructed as two separate roadways, that is, with a solid median wall separating the roadways. The ultimate maximum length of decking would be calculated, of course, on the worst condition

which is maximum traffic at rest.

While the 800 foot length of deck may be accepted as a general preliminary planning tool, final precise calculations may determine a somewhat longer decked length being permitted without mechanical ventilation. Whatever the finally calculated deck length, it must be kept in mind that joint development in the form of multi-storied air-rights buildings must not be planned adjacent to the deck openings. Such buildings should be set back 100 to 150 feet from the deck openings, depending on the height of the building, to insure that the building will not fall within the objectionable fume envelope.

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

UBJECT

T-4
working
#4

PRELIMINARY
SUBJECT TO STUDY & REVISION

Alf Howard

Ed Colby

March 13, 1974

CENTRAL ARTERY DEPRESSION STUDY
AIRED RAMPS

Following is a list of what I consider as necessary ramps to be provided in the design of the Depressed Central Artery:

A. Northbound Off-ramps

1. Frontage Road
2. Massachusetts Avenue
3. Massachusetts Turnpike
4. South Station and Downtown area
5. Northern Avenue for South Boston-Waterfront and Downtown area
6. Callahan Tunnel, North End, North Station area and Government Center by way of Chardon Street.
7. Storrow Drive
8. City Square

B. Northbound On-ramps

1. From Massachusetts Avenue
2. From Massachusetts Turnpike
3. From South Boston-Broadway-Frontage Road
4. From Downtown-South Station-South Boston in vicinity of Northern Avenue.
5. From Waterfront-Financial District-Government Center and Sumner Tunnel

6. From Storrow Drive

7. From City Square

C. Southbound Off-ramps

1. City Square

2. Storrow Drive

3. Government Center by way of Chardon Street is desirable but it may not be possible. This may have to be combined with the ramps serving the Callahan Tunnel and the Waterfront.

4. Callahan Tunnel-Waterfront

5. Downtown-Financial District, probably in the vicinity of Northern Avenue.

6. South Station-Dewey Square-South Boston area, probably at Summer Street.

7. Massachusetts Turnpike

8. Albany Street-South End-Back Bay at East Berkeley Street.

9. Massachusetts Avenue

D. Southbound On-ramps

1. From City Square

2. From Storrow Drive

3. From Sumner Tunnel-Government Center

4. From Waterfront-Financial District and Downtown area, probably at Purchase Street-Northern Avenue.

5. From Kneeland Street-South Station and Downtown area.

6. From Albany-South End-Back Bay

7. From Massachusetts Avenue

The Massachusetts Turnpike traffic will be combined with the [illegible] as it is today.

E. Third Harbor Tunnel

Connections to be made to and from Third Harbor Tunnel in both directions

F. Frontage Road

A system of Frontage Roads will be provided from Massachusetts Avenue to Causeway Street. If air-rights developments are out of the Waterfront Area, it is possible to place Frontage Roads over the depressed section to reduce ROW needs.

Perhaps we should all get together for a little work session and discussion of the above.

Edwin F. Colby
Deputy Director of Traffic Planning

cc: J. Moore Ede
E. McAllister

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

assachusetts Avenue □ Cambridge, Massachusetts 02138 □ Telephone 617-491-1421

T-5
#5

PRELIMINARY
SUBJECT TO STUDY & REVISION

IMBRIDGE
COUSTICAL
SSOCIATES

13 March 1974

To: Wallace, Floyd, Ellenzweig, Inc.

From: Cambridge Acoustical Associates, Inc.

Subject: Preliminary Traffic Noise Predictions for Central Artery Alternates

A. Configurations Evaluated

In order to assess the noise impact of various proposed alternates for the depressed Central Artery we have analyzed several basic configurations. The configurations include:

1. Fully elevated six lane roadway at 22 ft. above grade to represent the existing highway without ramps.
2. Fully depressed six lane roadway, 20 ft. below grade, uncovered.
3. A finite six lane roadway segment with a four percent grade, remainder of highway depressed.

B. Underlying Assumptions

In order to limit the comparison to the primary variables affecting urban traffic noise the following conditions were assumed:

1. Due to the high percentage of trucks (12 - 15 percent), noise from automobiles is neglected; the same volume applies to all configurations.
2. On the basis of previous experience in urban noise studies the effects of buildings on the propagation of noise into a given neighborhood is neglected.
3. The calculation of noise from the four percent grade segment is performed for the worst condition, i.e. the listener is located on a line perpendicular to the highway where it emerges from below grade; no shielding of due to the elevated structure beyond this point is included.
4. The 10 dB(A) difference between freely flowing traffic and stop and go

traffic is based on a published study of truck noise at toll booths and our own measurements of urban traffic noise.

5. In the noise prediction calculations observers are located at grade; higher observer locations will generally be exposed to more noise from all of the highway configurations evaluated depending on the relative elevations of source and observer.
6. Source elevation above roadway is assumed to be eight feet to account for the height of the engines and exhaust stacks typical of large trucks.
7. Each of the two sets of curves (Figs. 1 and 2) assume the same traffic flow conditions for all configurations. Comparisons between highway configurations with different flow conditions can be made using the two sets of curves.
8. Ambient noise in the residential - commercial area is based on measured data obtained by this firm in the same general area of Boston in 1972-1973 for highway noise impact studies.
9. All curves noise versus distance in Figs. 1 and 2 have a width of 3 dB(A) to account for the uncertainty in the prediction technique and other variables.

C. Discussion

It is clear that the traffic noise impact of the Central Artery can be reduced by partially or fully depressing the roadway, the more the better. Even the proposed four percent grade segment with the remainder of the Artery depressed results in an improvement over the existing fully elevated condition. Interrupted flow conditions should be avoided if at all possible. The four percent grade alone would not cause more than a 2 dB increase in the L_{50}, of trucks if it did not lead to actual flow interruptions or gross changes in vehicle speed. The effect on truck noise of large reductions in speed and attendant gear changes lies somewhere between the full flow (Fig. 1), and the interrupted flow conditions (Fig. 2).

FIG 1 TRAFFIC NOISE PREDICTIONS

FOR CENTRAL ARTERY - FREE FLOW

Cambridge Acoustical Associates, Inc.
1033 Massachusetts Ave.
Cambridge, Mass. 02138

SOURCE: 1500 TRUCKS/HR
40 MPH
FREELY FLOWING

ALTERNATE
WITH 4% GRADE

FULLY
ELEVATED
(EXISTING)

AMBIENT

FULLY DEPRESSED

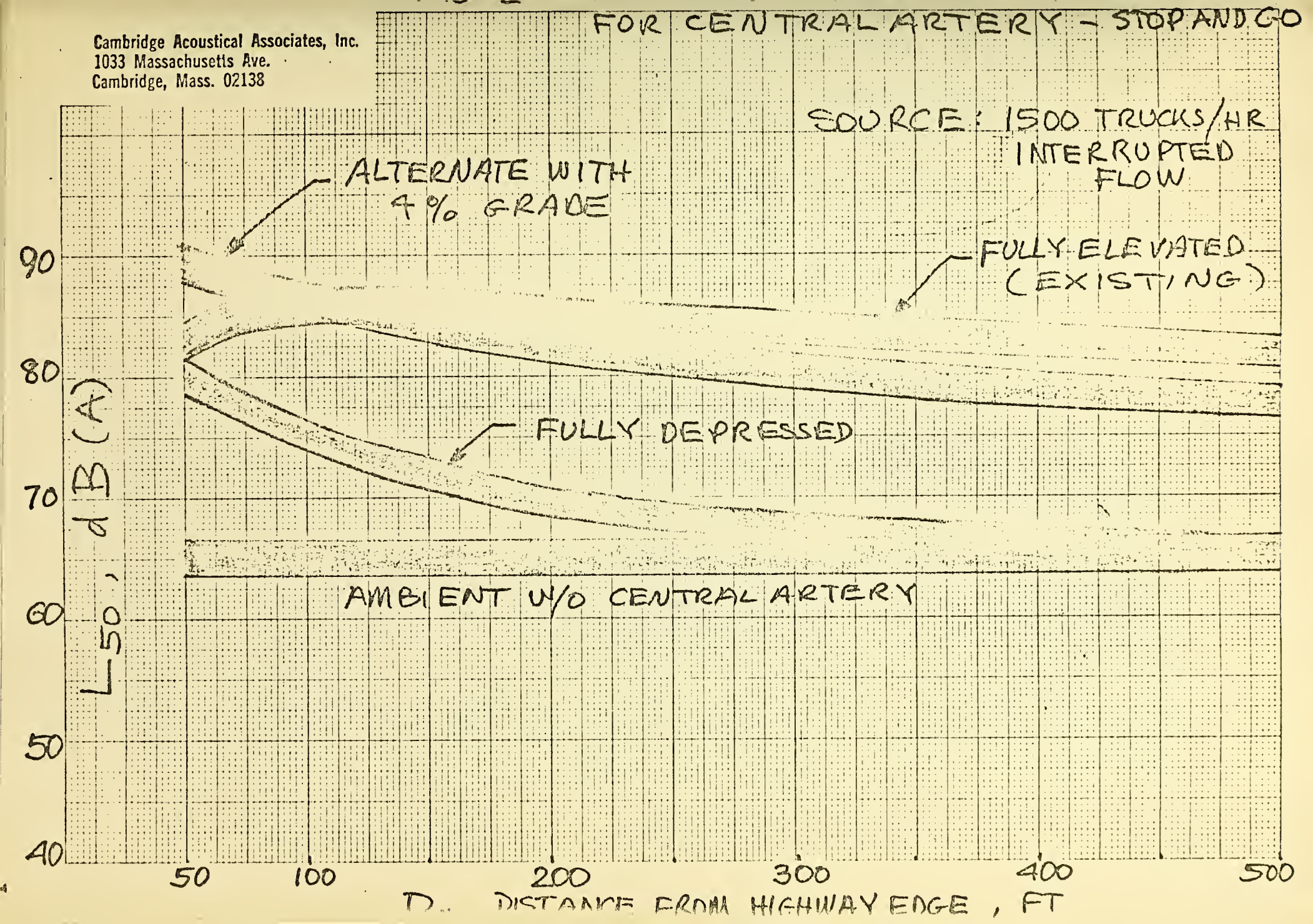
L_{50}, dB(A)

90
80
70
60
50
40

50 100 200 300 400 500

D DISTANCE FROM EDGE OF HIGHWAY, FT

Cambridge Acoustical Associates, Inc.
1033 Massachusetts Ave.
Cambridge, Mass. 02138



INTER-OFFICE COMMUNICATION

TO

FROM

DATE

JECT

ssachusetts Avenue □ Cambridge, Massachusetts 02138 □ Telephone 617-491-1421

T-6
#6

PRELIMINARY
SUBJECT TO STUDY & REVISION

VBRIDGE
CUSTICAL
SOCIATES

March 1974

: Wallace, Floyd, Ellenzweig, Inc.

om: Cambridge Acoustical Associates, Inc.

bject: Preliminary L_{10} Predictions for Central Artery Alternates (see memo dated 13 March 1974 for L_{50} predictions)

Configurations Evaluated

i. Existing: Elevated approx. 22 ft. above grade.

ii. Proposed low-level crossing: Fully depressed 20 ft. below grade.

iii. Proposed high level connector: Partially depressed, rising to existing level via 4% grade.

Assumptions

i. Truck volume during peak hour = 1500 vehicles
Truck volume during evening hours = 150 vehicles

ii. Observer is assumed to be at grade.

iii. Results (Fig. A attached) are shown for the section at which the high level alternate (iii.) produces its maximum impact. This is approximately at the Washington St. crossing.

iv. Anticipated truck speed profiles, ranging from 10-40 mph, are taken into account.

v. Predictions were based on the suggested Highway Research Board (HRB) procedures.

C. Discussion

Fig. A shows a comparison among the predicted L_{10} levels for the proposed alternates for both peak hour and evening conditions. These curves do not include the effects of noise transients (revving) due to gear shifting. However, calculations have been performed and show that the inclusion of such effects* would not change the relative positions for the L_{10} curves for the three proposed configurations. This is due, in part, to the assumed volumes and, in part, to the particularities of L_{10} as a parameter.

* Noise transients due to gear shifting add +6 to 8 L_{10}dbA to every L_{10} curve at 50 feet; this additional noise level contribution tapers off to +0 L_{10}dbA at 200 feet.

DAYTIME
PEAK HOUR 1500 HOURS/HOUR
1-½ GAUGE ALTERNATE

NIGHTIME
1500 TRUCKS/HOUR

EXISTING
ALIGNMENT

ALTERNATE
ALIGNMENT

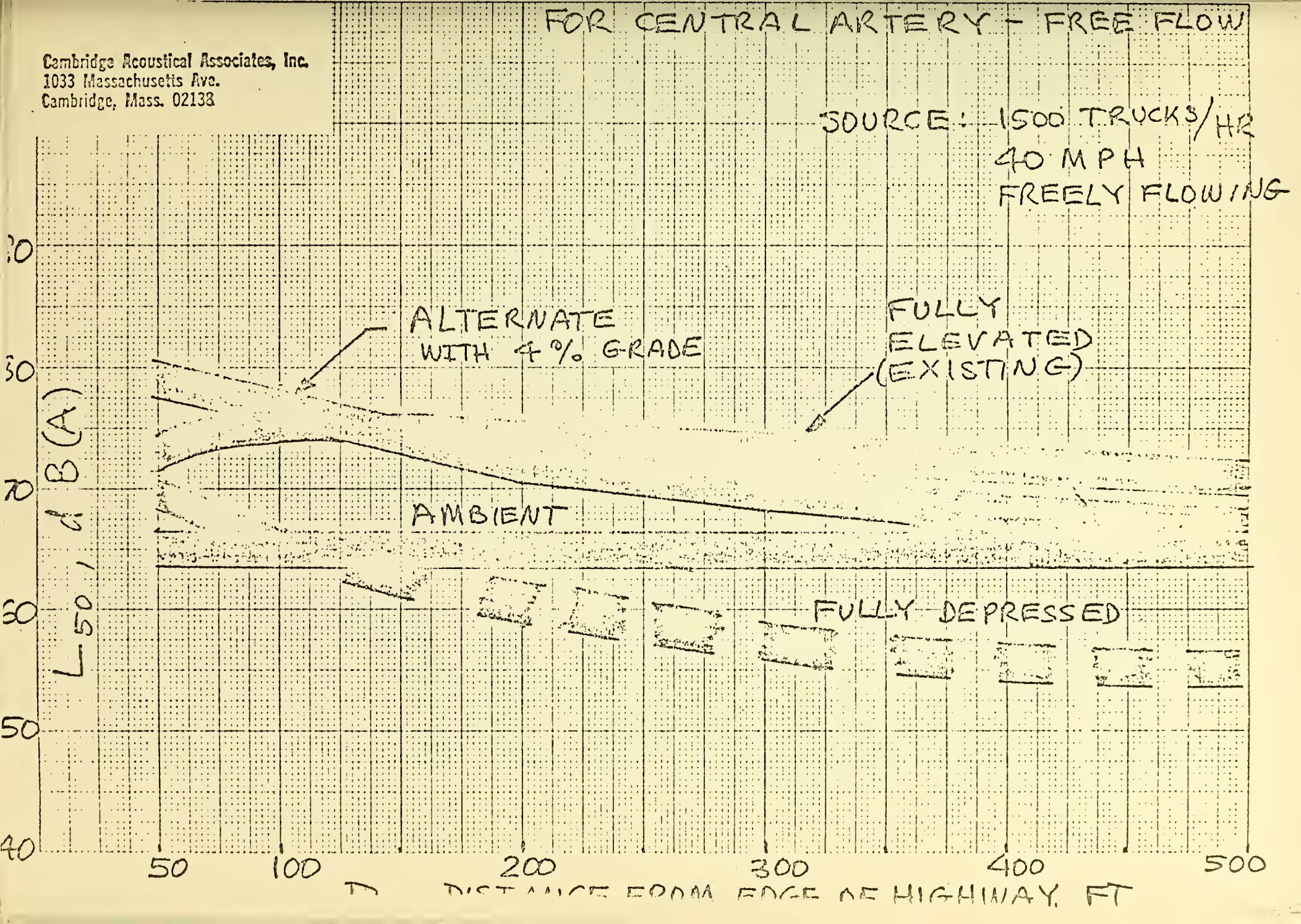
DEPRESSED
ALIGNMENT

DISTANCE TO CENTRE OF HIGHWAY, feet

Cambridge Acoustical Associates, Inc.
1033 Massachusetts Ave.
Cambridge, Mass. 02138

FOR CENTRAL ARTERY - FREE FLOW

SOURCE: 1500 TRUCKS/HR
40 MPH
FREELY FLOWING



INTER-OFFICE COMMUNICATION

TO

ROM

DATE

JECT

INTER-OFFICE COMMUNICATION

#7

TO Alf Howard, Project Manager

FROM Ed Colby

DATE April 8, 1974

JECT TRAFFIC USAGE
CENTRAL ARTERY SOUTHEAST EXPRESSWAY RAMPS

Following is a compilation of traffic volume information supplied by the Massachusetts Department of Public Works: these figures represent an average day for 1972 and show the volumes for each ramp between the Massachusetts Avenue Interchange and Causeway Street:

Southbound (1972) A.D.T.

At (location)	Entering	Exiting	On Artery
Jct. of Storrow Drive	-	-	53,550
Haymarket Exit	-	2,550	51,000
Causeway Ent.	6,600	-	57,600
North Street Exit	-	14,700	42,900
Haymarket-Cross Ent.	20,650	-	63,550
High Street Exit	-	11,500	52,050
Purchase Ent.	8,250	-	61,300
Dewey Square Exit	-	5,850	54,450
Congress Street Ent.	6,750	-	61,200
Beach Exit	-	3,750	57,450
Albany-Turnpike Exit	-	11,850	45,600
Kneeland-Turnpike Ent.	17,850	-	63,450
Albany Exit	-	5,250	58,200
Albany Ent.	13,000	-	71,200
Massachusetts Avenue Ent.	2,750	-	73,950
Massachusetts Avenue Exit	-	7,600	66,350
TOTALS	75,850	63,050	

Northbound (1972) A.D.T.

t (location)	Entering	Exiting	On Artery
South of			
rontage Rd. Exit	-	-	60,050
rontage Rd. Exit	-	9,350	50,700
assachusetts Avenue Exit	-	6,000	44,700
assachusetts Avenue Ent.	5,950	-	50,650
ast Berkeley Street Ent.	8,600	-	59,250
neeland-Turnpike Exit	-	18,500	40,750
urnpike-Broadway Ent.	20,450	-	61,200
outh Station Ent.	7,300	-	68,500
orthern-High Exit	-	12,300	56,200
ongress Street Ent.	10,350	-	66,550
orthern Avenue Ent.	7,850	-	74,400
linton Street Exit	-	6,400	68,000
allahan Tunnel Exit	-	15,950	52,050
tate Street Ent.	3,200	-	55,250
unnel Ramp Ent.	16,300	-	71,550
auseway Street Exit	-	9,350	62,200
TOTALS	80,000	77,850	

erhaps the most significant point borne out by the above figures s that while there are 110,000+ vehicles per day using the Artery in oth directions, at any one point, there are 300,000 vehicles entering nd leaving the Artery between Massachusetts Avenue and Causeway Street. his further complicates the problems of traffic detours and stagings uring construction.

t is also a fairly good indication that the percentage of "through raffic" must be quite low.

E. F. Colby

Edwin F. Colby
Deputy Director of Traffic Planning

INTER-OFFICE COMMUNICATION

TO

ROM

)ATE

JECT

PRELIMINARY: Subject to study & revision T-8

TO: CENTRAL ARTERY TECHNICAL COMMITTEE

FROM: Dick McAllister, B.R.A.

DATE: April 1, 1974

SUBJECT: CENTRAL ARTERY COMPARISON OF HIGH LEVEL VS. LOW LEVEL PROFILES - NORTH STREET TO CHARLES RIVER

In comparing the high level vs. low level profiles of the Central Artery Depression the critical factors for determining the feasibility of either profile are: grade, length of grade, truck speed, critical length of grade, capacity reductions, weave problems initiated with addition of truck climbing lane, and noise.

As presented in the technical memo "Central Artery Depression, impacts of long 4 Percent Grade" 12 March, 1974 by H. Benson, F. R. Harris, the high level crossing results in a new northbound roadway with a 4 percent grade of approximately 2,800 feet in length. This results in a 35 percent loss of capacity due to a 30 m.p.h. reduction in speed by trucks entering at 40 mph and climbing this long grade. This will create an unstable congested traffic flow. To alleviate this problem, a climbing lane 3,600 feet in length must be provided. This lane would start at the foot of the vertical curve, approximately 100 feet south of Hanover Street and continue into Charlestown to a location beyond

- more -

the point where the connection to the Tobin Bridge leaves the Central Artery - I-93 Corridor. This however, creates a weaving condition along the entire length of the truck climbing lane.

Trucks moving at speeds between 10 and 20 mph traveling in the extreme right hand lane will be in constant conflict with other vehicles, which are attempting to go to Storrow Drive or the Mystic Bridge. Because of the low speed of a truck in the climbing lane, any gaps in the truck traffic will be extremely undesireable for use by other traffic. Therefore vehicles in the second lane wishing to exit via the Storrow Drive ramp will have to slow to the same speed as the trucks to get to the exit ramp, causing a reduction in capacity in that lane.

A similar condition will occur at the crest of the climbing section. Trucks are now traveling at their slowest speeds, approximately 10 mph, in the far right hand lane. Some of these will, upon reaching the top of the grade, move across two faster moving lanes of traffic to get to Route I-93. These will be opposed by vehicles from the left hand lanes trying to go to the Mystic Bridge. As in the previous situation, traffic will be backed up because of the faster moving traffic slowing down to the speeds of the slower moving trucks in order to merge and weave.

The low level proposal has a grade of 4.75% for a distance of 1,100 feet. This is 250 feet longer than the critical length of grade of 850 feet. The critical length of grade is that at which a truck will have lost 15 mph in its velocity. This is the maximum speed reduction which can be tolerated without the addition of a truck climbing lane. In this case, a speed reduction of 18 mph will be experienced.

The low level profile, in which there is a theoretical reduction in capacity of 4.0%, also shows a reduction in demand on this section of roadway of approximately 1,800 vehicles/hour which have already exited to the Storrow Drive, Western Corridor sector prior to the start of the critical grade.

The L_{10} Noise levels were prepared by Cambridge Acoustical Associates and compare the contributions to the noise levels by trucks on the critical sections of grade. It must be remembered that these levels are the truck noise levels only and therefore there will not be as great a difference in ambient noise levels as apparent from Table I.

Conclusion:

It can be concluded from the above comparison that the high level profile cannot be made into an acceptable vertical alignment and should not be subject to further detailed study. However, since

the low level profile can be made to meet existing standards, it deserves the concentrated efforts of all involved.

TABLE I

HIGH LEVEL VS. LOW LEVEL

	EXISTING	HIGH	LOW
de	4.00%	4.00%	4.75%
gth of Grade	1100'	2800	1100'
tical Length Grade	1100'	1100'	850'
rage Truck[1] ed	31 mph.	21 mph.	30 mph.
imum Truck[2] ed	24 mph	10 mph.	22 mph.
senger Car[1] valent	3.7	9.7	4.0
city/hr	4700	3065	4510
nd	4700	4700	2710
city[1] ction		- 35%	- 4%

	Day	Night	Day	Night	Day	Night
50'	78 db	72 db	84 db	78 db	74 db	67 db
100'	78 db	70 db	82 db	75 db	70 db	60 db
500'	73 db	64 db	73 db	62 db	57 db	47 db

1. AASHO Geometric Design Policy Tables V-3, V-4

2. ibid Fig III - 17

3. Cambridge Acoustical Associates
Preliminary L_{10} Predictions for the Central Artery 19 March 1974

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

CENTRAL
ARTERY
FEASIBILITY
STUDY

Community Liaison &
Technical Assistance

Boston City Hall
Room No. 941

(617)·722·4473

#9

6-7-74

TECHNICAL MEMORANDUM

TO: Central Artery Study Staff

FROM: Jim Brennan, Community Liaison & Technical Assistance

SUBJECT: Review of I-93/Mystic Bridge/Central Artery Connections in Charlestown Proposed by Bill Lamb of the Sierra Club

An examination of this proposal indicates that it is not possible to make the connections shown in the schematic design, even according to the most relaxed geometric standards. More specifically, the following connections present major difficulties:

- Southbound Mystic Bridge to Central Artery. There is not sufficient room to make this connection as it appears in the schematic. This connection is precluded by both structural interference and geometric inadequacies.

- Southbound I-93 to Mystic Bridge. It is not possible to merge the Southbound I-93 traffic bound for the Mystic Bridge into the interchange without creating a potentially hazardous substandard weaving condition at the mouth of the proposed Mystic Bridge approach tunnel.

Although this design in its present form has some serious drawbacks, the conceptual basis for the design probably deserves further consideration and refinement. In essence, this scheme attempts to take the interchange of I-93, the Mystic Bridge and the Central Artery out of City Square in Charlestown and relocate it in the area bounded roughly by the Charles River, the Charles River Dam, the Prison Point Bridge and the existing I-93. Its major benefit relative to the existing and proposed designs is that it does not have as much negative impact on the residential areas of Charlestown as the other alternatives.

Pursuing the development of this concept raises some interesting policy and technical questions. It appears that it is feasible (in the engineering sense) to construct the necessary connections provided that these connections are viewed as an interchange, with ramp connections and ramp design criteria applied where necessary. Based on the preliminary analysis conducted here, it does not appear to be possible to construct the necessary connections within the prescribed area (and, implicitly, removing much of the overhead structure in the vicinity of City Square) if the interface of the three major roadways is designed to be a high-type connector with a 40 mile per hour design speed throughout.

It appears that if the interface of I-93, the Central Artery and the Mystic Bridge can be viewed as an interchange, the most promising configuration seems to be a trumpet-type arrangement, with the Southbound I-93 to Mystic Bridge connection making the inner loop around the trumpet (See Figure 1).

Several technical issues must be considered in developing this alternative. Some of these are as follows:

- Capacity constraints. A trumpet-type interchange has been used generally to carry volumes of traffic much smaller than those in the study area. A careful capacity analysis of any proposed configuration would be required.

- Mystic Bridge. In order to depress the Mystic Bridge approach through City Square, the entire approach to the bridge would have to be rebuilt at least as far as Tremont Street in Charlestown to meet the existing grade. Reconstruction of the bridge with Interstate funding would not appear to be possible without eliminating the sharp reverse curve in the bridge approach near Henley Street and Lowney Way. Eliminating this curve would require displacing the depressed section towards City Square. This reconstruction of the bridge approach would also reduce the amount of available cross access to the Waterfront between City Square and Tremont Street.

- Construction Staging. This alternative would require a completely new construction staging analysis, since it differs radically from the proposed project in its treatment of the Charlestown connections.

- North Terminal Study. Many of the issues relevant to this concept were raised during the North Terminal Study. They should be reviewed as part of the process of formulating this alternative.

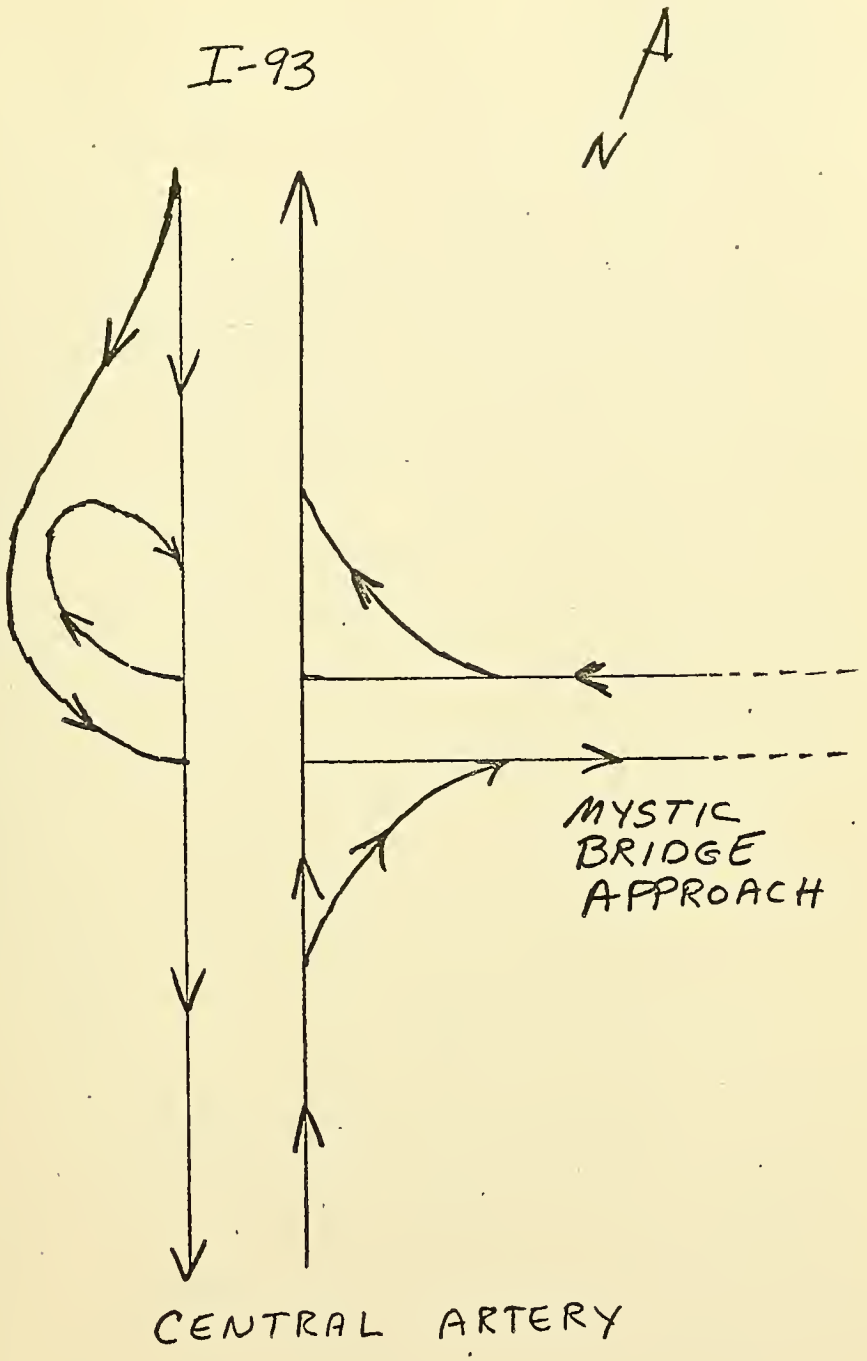


FIGURE 1
SCHEMATIC OF PROPOSED I-93/CENTRAL ARTERY/MYSTIC BRIDGE CONNECTIONS

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

T-10

#10

HARRIS

oderic R. Harris, Inc., Consulting Engineers, Long Wharf, Boston, Massachusetts 02110 617-723-1700

June 20, 1974
08-595-01

Mr. Alfred Howard
Boston Redevelopment Authority
City Hall - Room 900
1 City Hall Square
Boston, Massachusetts 02201

RECEIVED
JUN 21 1974
TRANSPORTATION
PLANNING DIVISION

Re: Central Artery Depression Study

Dear Mr. Howard:

Attached is a nine page report covering our recent evaluation of ventilation requirements for the Depressed Central Artery.

The report speaks pretty well for itself. However, in summary it appears that:

1. The longitudinal slot over the median will require 50% of the roadway to be open, thus making decking much less attractive.

2. The intermittent decking without ventilation runs on the order of 600 feet of deck and 500 feet of opening. As the document shows, the 500 feet of opening is necessary to accomodate the eye's adaptation to light changes rather than tunnel ventilation.

At this point in time, it might be wise to orient your urban planning and land use schemes around the idea of decking 3,000 foot sections of the Artery. These sections could be longitudinally ventilated with fans and chimneys and would not require any additional depressed cross sectional area. Full decking with full mechanical ventilation would require such extensive duct space as to preclude fitting an Artery of this concept within our present confines.

It is our feeling that the attached report adequately addresses the Central Artery ventilation problem and it is our intention to pursue the matter no further.

HARRIS

Should additional ventilation studies be deemed necessary, they would entail complex modelling and testing and would require additional funding.

Very truly yours,

FREDERIC R. HARRIS, INC.

Herbert G. Benson

Herbert G. Benson
Project Manager

HGB:pk

Encl: 2 copies of report

cc: Mr. David Wallace w/encl.

HARRIS

Frederic R. Harris, Inc., Consulting Engineers, 300 E. 42nd St., New York, N.Y. 10017 212-985-2700 Cable Harkob Telex 22-135

JUN 19 1974

BRA

#08-595-01

HB

June 14, 1974

Mr. H. Benson
Frederic R. Harris Inc.
68 Long Wharf
Boston, Massachusetss 02110

Dear Mr. Benson:

Clarence Freeman and I have reviewed the plans you sent for ventilating the Depressed Central Artery. We have made a short library survey of the state-of-the-art and have contacted a number of people in private and public organizations in order to arrive to some sort of a consensus and judgment of the feasibility of the schemes considered.

As a result of our preliminary study we do not believe that further consideration of natural ventilation alone should be given to ventilation plans for the Depressed Central Artery. The reasons for this will be discussed herein together with the presentation of several practical schemes utilizing artificial ventilation schemes.

However, we would like to emphasize that the definitive study of ventilation for heavy volume traffic tunnels is an extremely complex subject and in the short period of time and under the limited budget available for this study only a few broad concepts can be presented.

An excellent review of methods of ventilating traffic tunnels has been recently completed (1972) by the Transport and Road Research Laboratory of Great Britain (Ref. 1). An important quotation from this work is:

> "Much of the information required to design a ventilation system for a road tunnel is still not known precisely and consequently there are considerable variations in the practice and standards used by different authorities. In a situation where life and health could be at risk it is not surprising that the tendency has been towards caution and over-ventilation. The object of this report is to review and examine the existing methods used to ventilate road tunnels and thereby indicate those areas where further development and research would be worthwhile."

Although this approach is applicable to both natural and artificial ventilation systems, the field of natural ventilation is by far the most unsettled and the maximum safe length of tunnel which can be built without continuous artificial ventilation is not accurately known and would vary depending upon many extremely variable conditions.

The British have also researched the possibilities of natural ventilation extensively in connection with the design and construction of high traffic volume access tunnels at London Airport. (Reference 2). We have reviewed this work as it applies to the proposed Depressed Central Artery. An associated British study (Reference 3) includes a world-wide survey through mid-1965 of traffic tunnels over 500 feet long, including those artifically and naturally ventilated. We do not think that there has been any significant change in the overall data presented since that date that would change conclusions using results of this survey.

We have summarized the survey information on naturally ventilated tunnels on Attachment 2, plotting length of tunnel versus maximum number of vehicles per day in one tunnel tube.

Also on this graph we have drawn a line representing the maximum number of vehicles per tube proposed for the Depressed Central Artery. We have also added FHWA maximum safe length of tunnel which can be permitted without artificial ventilation. It will be seen that any traffic volume greater than 20,000 per day per tube with a tunnel length over 500 feet is an extrapolation far outside of generally accepted practice. The FHWA criteria of 600 ft. maximum safe length with natural ventilation (no traffic volume limitation) is also completely consistent with the statistical data. It should be noted that the FHWA does allow consideration of an 800 ft. length (no traffic volume limitation) if natural ventilation capabilities can be proven.

However, the provision of natural ventilation involves the orientation and profile of the tunnel, the topography and configuration at the exit portals. The assessment of prevailing wind conditions and "chimney effects" and other atmospheric conditions. However, traffic holdups in the tunnel can always cause serious contamination.

Thus it would be unwise to build a busy traffic tunnel of lengths greater than 600 feet without provision for artificial ventilation that would be activated when the CO contamination reached a dangerous level.

The following is a discussion of several schemes including FWHA limitations and criteria:

HARRIS

A. The Longitudinal Slot Scheme. This scheme appears not to be feasible for natural ventilation unless 50 percent or more of the roadway is exposed to the sky such as the commonly used cantilever schemes. Once less slot width is provided, extensive ventilation calculations would have to be made including modeling. It is not a promising scheme from the structural point of view either.

B. The Intermittent Deck Scheme. This scheme has severe limitations placed upon it by FWHA in that it requires the following constraints:

1. Maximum length of tunnel or overpass without mechanical ventilation or detailed proof that none is needed ..... 600 feet.

2. Tunnel or overpass lengths for which detailed substantiation is required to show that mechanical ventilation is not required ..... 600-800 feet. Mechanical ventilation required for tunnels over 800 feet.

3. The minimum undecked section length is set at 500 feet. This requirement has more to do with eye adaptation to light than to ventilation requirements.

The consequence of these criteria is that they seem to suggest that the Central Artery should be left entirely or substantially open to the sky or that a minimum cost ventilation system should be considered. The 13,500 feet could be broken up into four ventilated, decked-over sections 3000 feet long each, separated by three 500 foot undecked sections. Each 3000 foot deck section would be ventilated by a longitudinal system which would not require additional duct space. Ventilation would be so arranged to make best use of the piston effect of the moving traffic which could normally supply a substantial portion of the required ventilation, with fans supplying air at traffic standstill or low velocity traffic conditions.

HARRIS

C. Ventilation Volume Required. Currently the FWHA is approving designs based on maintaining no more than 250 ppm of Carbon Monoxide (CO) in the tunnel at worst traffic condition, piston and wind effects excluded. Worst conditions are obtained at traffic standstill or at 0 to 15 mph, depending on what source of vehicle CO emission data one uses. The 250 ppm standard as used by FWHA is in connection with CO emissions from unregulated vehicles, that is, pre-emission control vehicles. FHWA is currently using CO emissions published in a Swiss Report(1.). The figures in that report are not available to us at this writing, but EPA data on 1965 passenger cars is. These are appended as Basic Data.

The FWHA also uses as rule-of-thumb, the figure of 100 CFM of air per lane foot of tunnel or overpass to judge ventilation adequacy. This criterion would yield less ventilation air required, because of the unusually high lane vehicle counts predicted for the Central Artery.

The EPA is talking about tunnel ventilating standards to limit CO to 50 ppm for the worst hour and 250 ppm for the worst 8-hour span (31 ppm per hour average). These are not in effect but indicate the problems to be faced by tunnel designers should this thinking prevail.

---

1 Report of Commission on Tunnel Ventilation to Swiss Department of Highways, September 1959, Bulletin No. 10 Institute for Highway Construction of Swiss Institute of Technology, Zurich.

DARRIS

D. Environmental Impact. National Ambient Air Quality Criteria are appended. They are severe, and each metropolitan area is required to file an implementation plan. Arterials like the Central might be in contravention of these Criteria especially if the Arterial Vehicle pollution is added on to an ever-rising non-vehicular background level of air pollution. This condition might have to be studied by air diffusion model to satisfy the EPA in an Environmental Impact Statement (EIS). In connection with mechanical ventilation systems, the exhaust stack areas and tunnel portals discharging piston effect exhaust air would have to be studied to minimize adverse environmental effects.

E. Longitudinal Ventilation System. As mentioned above, the longitudinal system of ventilating seems to be least expensive a method since it requires no additional duct space and since there seem to be possibilities of finding space at intermediate points for ventilation stack structures. The absolute maximum length that can be ventilated by this method is probably in the vicinity of 3000-4000 feet because of the high volumes of air required. This judgement will need verification by a more detailed study at an appropriate time.

If suitable intermediate points cannot be found for ventilation structures, then semi-transverse or fully transverse ventilation systems could be considered. They would entail considerably more expense of the separate duct space needed.

A preliminary summary of the ventilation requirements of various lengths of decked-over artery is given in a separate attachment.

Seymour M. Klein

Clarence P. Freeman

HARRIS

APPENDIX: BASIC DATA

1. National Ambient Air Quality Criteria

Pollutant	Level Not To Be Exceeded
Carbon Monoxide (CO)	35 ppm (1-hour average)* 9 ppm (8-hour average)*
Hydrocarbons (HC)	0.24 ppm (6-9 AM average)**
Oxides of Nitrogen (NO_x)	0.05 ppm (annual average)

* not to exceed more than once a year
** equivalent to a 1-hour average of 0.29 ppm

2. Emission of CO by Passenger Cars (Source: EPA)

Speed (mph)	CO Emission Lbs/Mile/Year		
	1965 (pre-control)	1972 (partial control)	1975 (full cont
10	.56	0.39	.27
15	.34	0.25	0.20
25	.25	0.165	0.12
40	.22	0.145	0.10

ATTACHMENT #1 VERY PRELIMINARY SUMMARY OF VENTILATION AIR REQUIREMENTS - DECKED-OVER ARTERY - ONE WAY

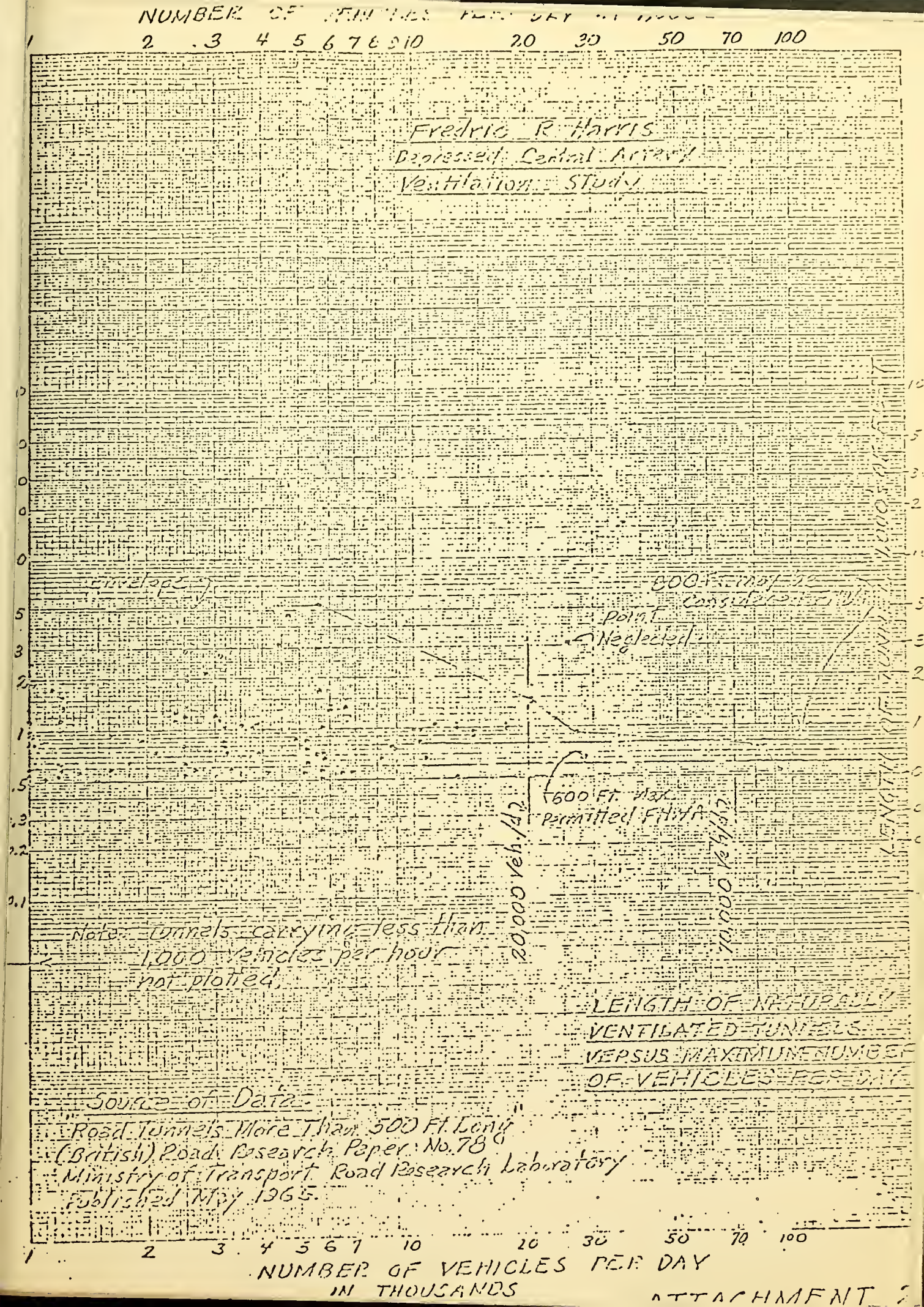
Maximum Unventilated Underpass Length Now Is 600 Feet.

DECKED-OVER:

Length Ft.:	1,000	1,500	2,000	4,000
Miles:	0.2	0.3	0.4	0.8
TUNNEL ADT	70,000	70,000	70,000	70.000
Maximum VPH:	7,000	7,000	7,000	7,000
Vehicles per Minute, 3 Lanes:	117	117	117	117
TOTAL VEHICLE TUNNEL MILES/MINUTE:	23	35	47	94
TOTAL CO EMISSION @ 10 MPH (LBS.) 1965 CAR @ 0.56 (LBS.) of CO/VM	12.9	19.5	26.5	52.5
VENTILATION VOLUME @ 13 CF/LB, AIR CFM	675,000	1,000,000	1,380,000	2,700,000
AIR VELOCITY IN TUNNEL ASSUMING LONGITUDINAL VENTILATIONAL WITH AIR INLET AT PORTALS & CENTER EXHAUST. (700 S.F. - TUNNEL AREA) FPS	8	12	16.5	33
RULE OF-THUMB-AIR REQUIREMENT FOR VENTILATING AIR IN TUNNEL 3-LANE ROADWAY CFM	300,000	450,000	600,000	1,200,000
4-LANE ROADWAY CFM	400,000	600,000	800,000	1,600,000

Approximate Tunnel Air Velocity generated by maximum hourly traffic court at various traffic velocities: (Piston Effect)

Traffic Velocity	Induced Air Velocity
10 mph	7 fps
20 mph	12 fps
40 mph	19 mph


NUMBER OF VEHICLES PER DAY IN THOUSANDS
1 2 3 4 5 6 7 8 9 10 20 30 50 70 100
Fredric R. Harris
Depressed Central Artery
Ventilation Study
Envelope
600 Ft. may be considered as Point Neglected
600 Ft. Max. Permitted Fire Hazard
Note: Tunnels carrying less than 1,000 vehicles per hour not plotted.
LENGTH OF MECHANICALLY VENTILATED TUNNELS VERSUS MAXIMUM NUMBER OF VEHICLES PER DAY
Source of Data:
Road Tunnels More Than 500 Ft. Long (British) Road Research Paper No. 78 Ministry of Transport Road Research Laboratory Published May 1965.
NUMBER OF VEHICLES PER DAY IN THOUSANDS

ATTACHMENT 2

HARRIS

Frederic R. Harris, Inc., Consulting Engineers, 300 E. 42nd St., New York, N.Y. 10017 212-935-2700 Cable Harkob Telex 224135

LIST OF REFERENCES

(1) "A Review of Methods of Ventilating Road Tunnels"
by H. J. Hignett and L. Hogbin,
Transport and Road Research Laboratory,
Department of the Environment
TRRL Report LR477 Great Britain 1972

(2) "Self-Induced Ventilation of Road Tunnels"
Engineer, London, June 24, 1960,
Pages 1069-1074.

(3) "Road Tunnels More Than 500 Feet Long"
Road Research Laboratory,
Ministry of Transport,
Great Britain Road Research Technical
Paper No. 78
Her Majesty's Sationery Office

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

BJECT

CENTRAL
ARTERY
FEASIBILITY
STUDY

Community Liaison &
Technical Assistance

Boston City Hall
Room No. 941

(617)-722-4473

7-11

MEMORANDUM

To: Persons Attending Working Committee of Monday, July 1st., 1974

From: Central Artery Feasibility Study Staff

Re: RAIL CONNECTION -- Inter-Office Communication Memorandum
by Ms. Julie Moore Ede, Environmental Cordinator

TITLES FOR FIGURES IN RAIL MEMO APPENDIX

. Railroad Network in the Boston Region

. Branch Names

. Peak Hour Inbound Ridership, August 1972; Thomas K. Dyer, System = 8,162

. Daily Inbound Ridership MBTA Area Only, August 1972; Thomas K. Dyer, System = 12,714

. Daily Inbound Ridership, August 1972; Thomas K. Dyer, System = 15,610

. Daily Inbound Ridership, 1980 BTPR; Moderate Investment Network, Upgraded Commuter Rail System, No Rail Connection, System = 17,770

. Daily Inbound Ridership, 1980 BTPR; Moderate Investment Network, Upgraded Communter Rail, System = 20,310

. Daily Inbound Ridership 1980 Electrified Commuter Rail/Rapid Transit*, System = 21,346

*NOTE: Rapid transit extended to Pines River, Reading, Rte. 128-Lexington and Rte. 128-Needham.

. Daily Inbound Ridership 1980 Electrified Commuter Rail/Rapid Transit, Community Growth; a change in the modal split, existing ratio peak: daily ridership, System = 41,300

INTER-OFFICE COMMUNICATION

TO Working Committee and Other Interested Persons

ROM Julie Moore Ede, Environmental Coordinator

DATE July 1, 1974

JECT RAIL CONNECTION

Attached is a preliminary analysis of the ridership and service potentials of a North to South Station rail connection.

I would appreciate any questions on this material either at the meeting or before July 5th.

Julie F. Moore Ede

Julie Moore Ede
Environmental Coordinator
aura

JME:jcg
Attachment

CENTRAL ARTERY FEASIBILITY STUDY

SUMMARY AND CONCLUSIONS

C) Findings and recommendations

The principal finding is that a tunnel for conventional railroad equipment between North and South Stations is possible and practical. This tunnel would handle commuter railroad trains as well as Amtrak trains and is expected to cost in the neighborhood of $106 million dollars. The electrification of the tunnel and railroad system is optional and not mandated by the tunnel, the decision to do this being made on its own merits.

The movement of goods by freight car during off peak hours is possible. This goods movement may be locally destined or through, it being possible to move freight from the West, through Beacon yards and the tunnel to the North should it be desired. An alternate is the Grand Junction Branch with street crossings in Cambridge. Longer freight trains will require the use of multiple locomotive power.

On an initial capital cost/daily user basis (not a daily user cost) the tunnel compares favorably with other mass transit projects which have been justified in the past. If the South Shore line's $75 million dollar cost were allocated to its 28,990 two-way second year riders it would amount to $2590 per user. The rail connections $106 million dollar cost allocated to its 40,620 first year two way riders (BTPR moderate investment network) would amount to $2610 per user.
According to computer analyses, a maximum speed slightly in excess of 30m.p.h. could be operated through the tunnel with freight or passenger equipment of various types. A three minute headway can be operated in the tunnel with thirty second station dwell time. This can be achieved with the high platforms to be provided and new equipment or modified existing equipment. An example of this modification would be to take an existing Budd rail diesel car (RDC) and remove the lockers and rest rooms from the ends of the cars. This would allow double doors at all four corners. If half of the eighty-five riders utilized the busiest station then eleven passengers would utilize each single door.

At 2 seconds unloading time per passenger, 22 seconds dwell time would be required.

If all lines utilized 6 car trains (the maximum allowed at all stations in the connection but South Station) a one way capacity of 10,200 seats per hour could be operated (all passengers seated). With new or converted 90 passenger electric equipment this would go up slightly to 10,800 seats per hour. It is felt that the numbers of standees should be kept to a minimum. As the present lines do not have the ridership volumes to justify 6 car trains on all lines, this capacity will not be fully utilized. By 1980, CRIP forecasts a 42% increase over present day volumes. As the rapid transit system expands, and causes some branches to be converted and as ridership increases, less total trains of longer length can be expected to be operated. For comparison, a rapid transit connection operated with 6 car-trains of the South Shore type could provide a capacity of 12,240 seats per hour in one direction.

It is felt that with significant investment in the commuter rail system in addition to the provision of the connection a conservative estimate of 21,346 ~~one-way~~ INBOUND riders would utilize the connection IN THE COURSE OF A DAY.

Market studies have shown that the Boston to New York corridor has a potential of 8375 riders per day under the Northeast corridor system as authorized by Congress.

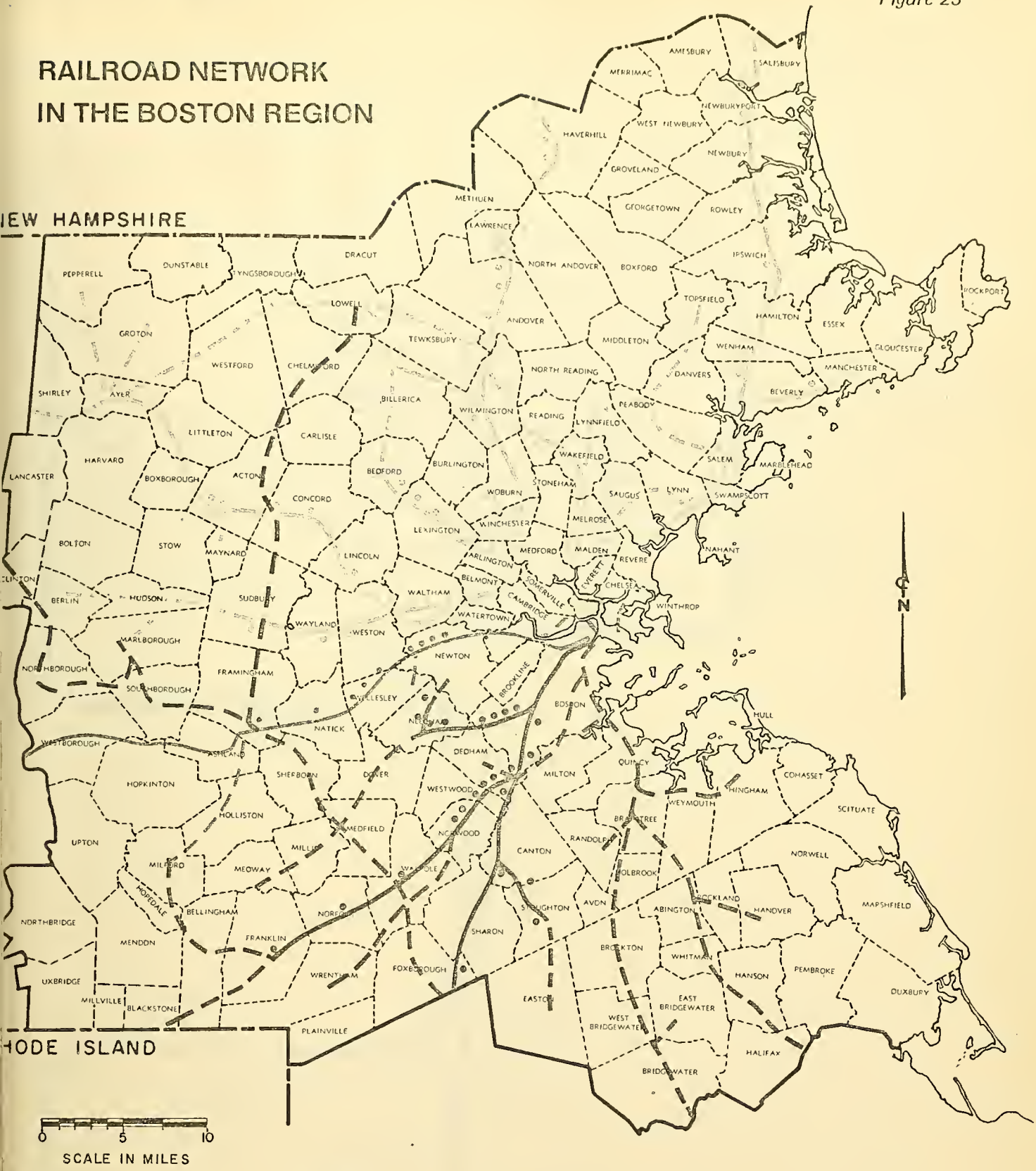
A limit on tunnel usage would probably be that attained with the BTPR full core distributer--48,400 daily INBOUND riders.

WITH A COMBINATION OF COMMUNITY GROWTH AND A CHANGE IN THE MODAL SPLIT BROUGHT ABOUT BY ENERGY AND ENVIRONMENTAL CONSIDERATIONS, BUT WITH THE EXISTING RATIO OF PEAK TO OFF-PEAK USAGE, 41,300 INBOUND RIDERS WOULD UTILIZE THE CONNECTION

APPENDIX

Figure 23

RAILROAD NETWORK IN THE BOSTON REGION

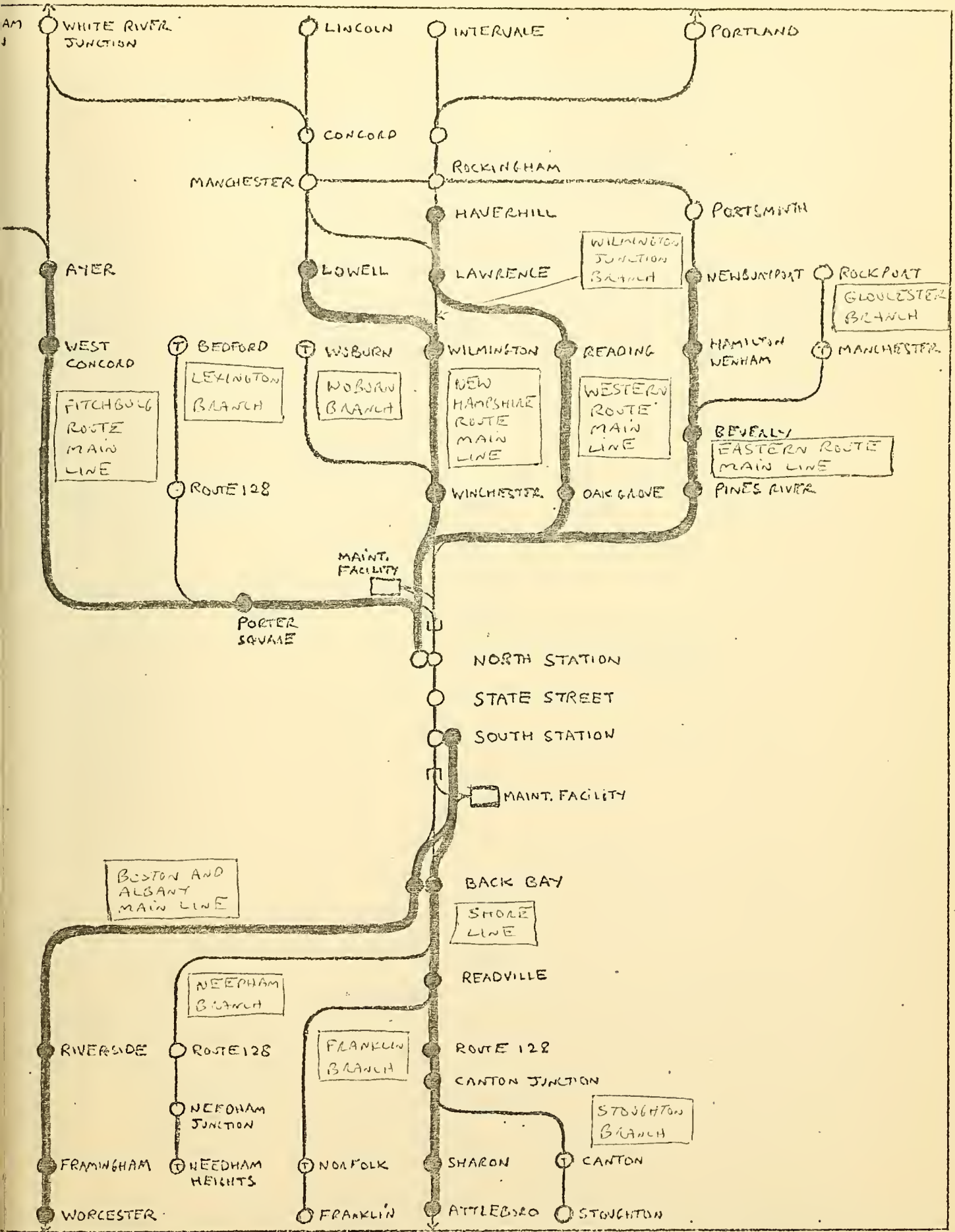


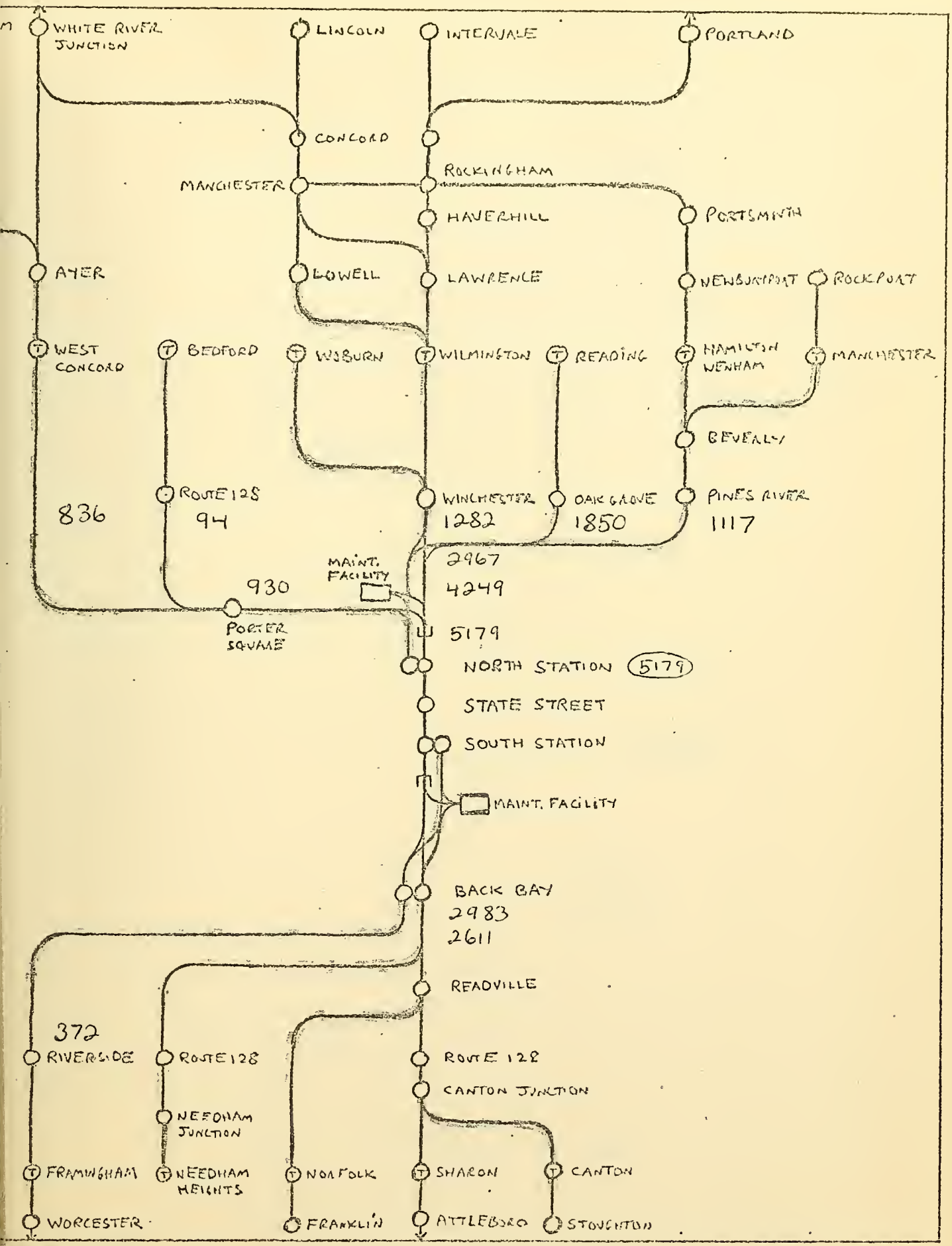
LEGEND:

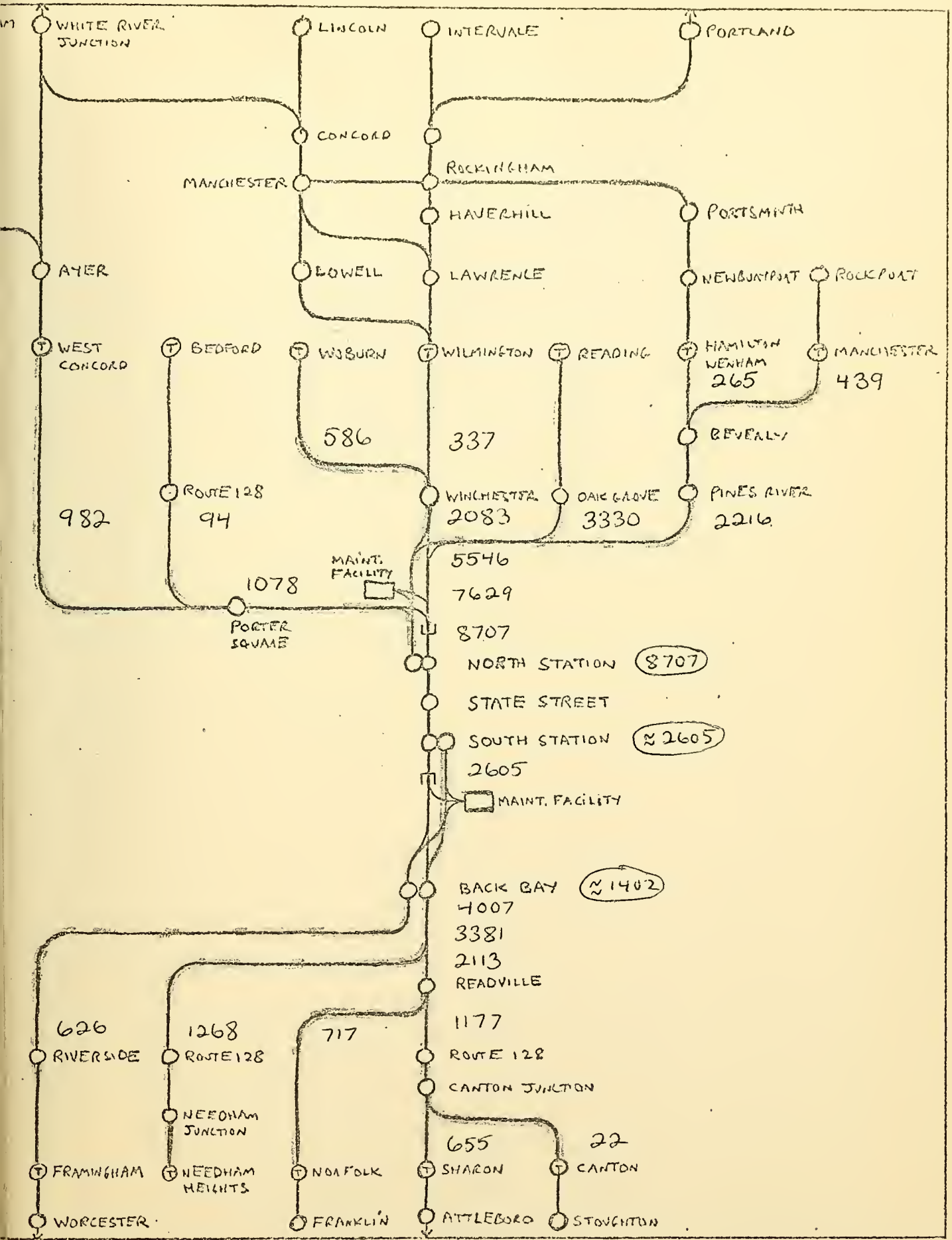
- STATIONS
- PASSENGER AND FREIGHT SERVICE
- FREIGHT SERVICE ONLY
- BOSTON AND MAINE RAILROAD
- NEW YORK, NEW HAVEN AND HARTFORD RAILROAD
- PENN-CENTRAL RAILROAD

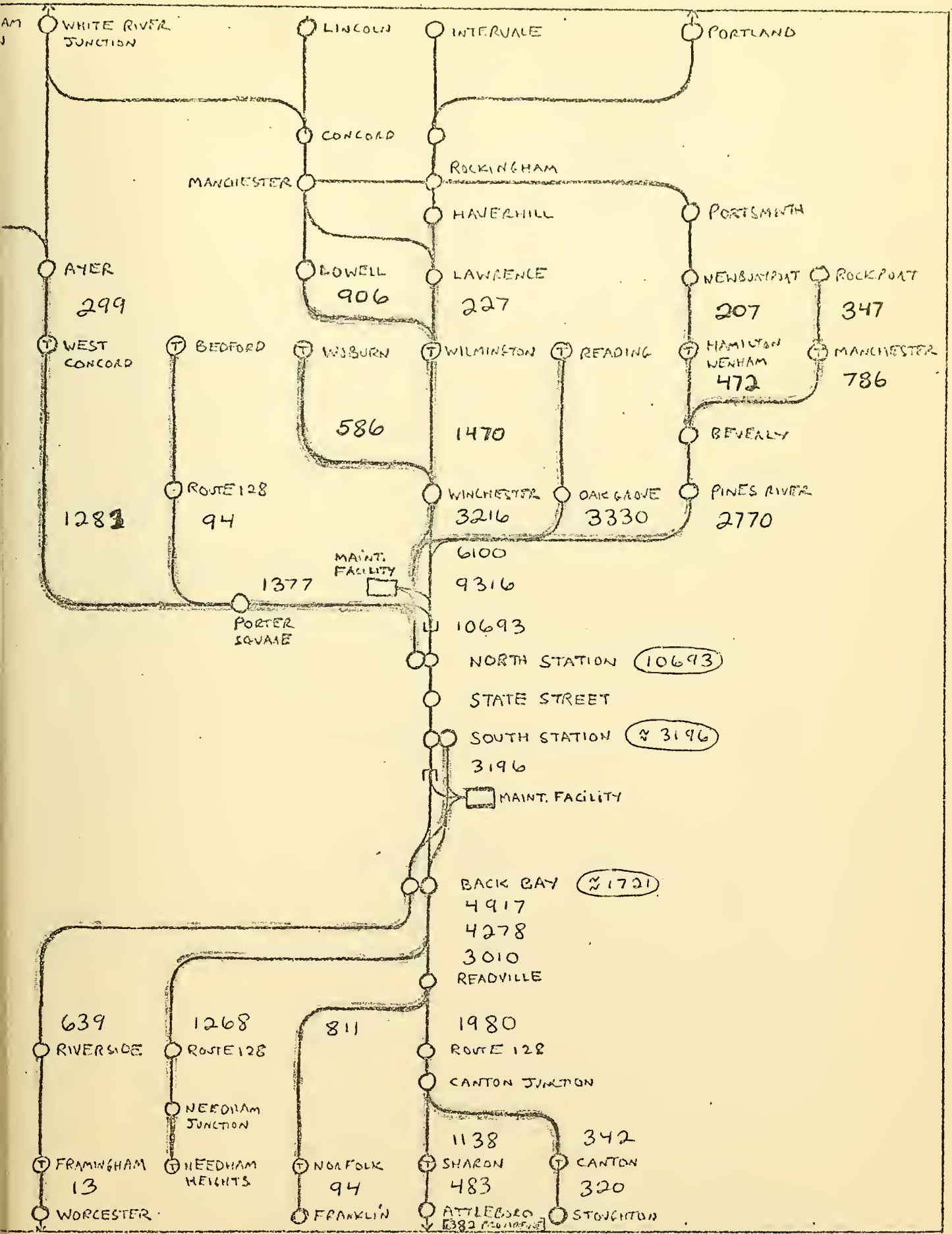
SOURCE / Boston Redevelopment Authority

August 1968


WHITE RIVER JUNCTION
LINCOLN
INTERVALE
PORTLAND
CONCORD
ROCKINGHAM
MANCHESTER
HAVERHILL
PORTSMOUTH
AYER
LOWELL
LAWRENCE
WILMINGTON JUNCTION BRANCH
NEWBURYPORT
ROCKPORT
GLOUCESTER BRANCH
WEST CONCORD
BEDFORD
WOBURN
WILMINGTON
READING
HAMILTON WENHAM
MANCHESTER
FITCHBURG ROUTE MAIN LINE
LEXINGTON BRANCH
WOBURN BRANCH
NEW HAMPSHIRE ROUTE MAIN LINE
WESTERN ROUTE MAIN LINE
BEVERLY
EASTERN ROUTE MAIN LINE
ROUTE 128
WINCHESTER
OAK GROVE
PINES RIVER
MAINT. FACILITY
PORTER SQUARE
NORTH STATION
STATE STREET
SOUTH STATION
MAINT. FACILITY
BOSTON AND ALBANY MAIN LINE
BACK BAY
SHORE LINE
READVILLE
NEEDHAM BRANCH
RIVERSIDE
ROUTE 128
FRANKLIN BRANCH
ROUTE 128
CANTON JUNCTION
NEEDHAM JUNCTION
STOUGHTON BRANCH
FRAMINGHAM
NEEDHAM HEIGHTS
NORFOLK
SHARON
CANTON
WORCESTER
FRANKLIN
ATTLEBORO
STOUGHTON

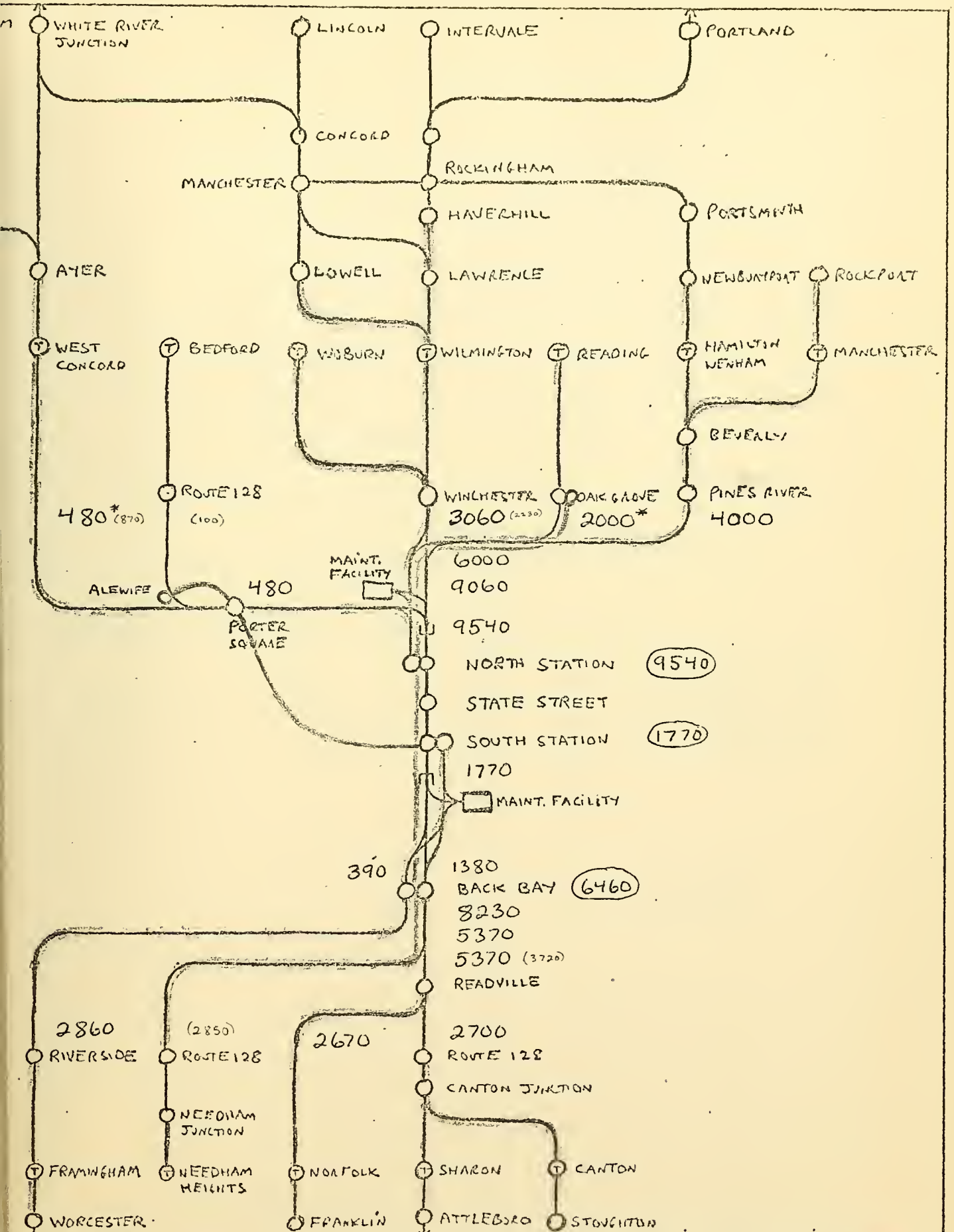

WHITE RIVER JUNCTION
LINCOLN
INTERVALE
PORTLAND
CONCORD
ROCKINGHAM
MANCHESTER
HAVERHILL
PORTSMOUTH
AYER
LOWELL
LAWRENCE
NEWBURYPORT
ROCKPORT
WEST CONCORD
BEDFORD
WOBURN
WILMINGTON
READING
HAMILTON WENHAM
MANCHESTER
BEVERLY
836
ROUTE 128
94
WINCHESTER
1282
OAK GROVE
1850
PINES RIVER
1117
2967
MAINT. FACILITY
930
4249
PORTER SQUARE
5179
NORTH STATION
5179
STATE STREET
SOUTH STATION
MAINT. FACILITY
BACK BAY
2983
2611
READVILLE
372
RIVERSIDE
ROUTE 128
ROUTE 128
CANTON JUNCTION
NEEDHAM JUNCTION
FRAMINGHAM
NEEDHAM HEIGHTS
NORFOLK
SHARON
CANTON
WORCESTER
FRANKLIN
ATTLEBORO
STOUGHTON


WHITE RIVER JUNCTION
LINCOLN
INTERVALE
PORTLAND
CONCORD
MANCHESTER
ROCKINGHAM
HAVERHILL
PORTSMITH
AYER
LOWELL
LAWRENCE
NEWBURYPORT
ROCKPORT
WEST CONCORD
BEDFORD
WOBURN
WILMINGTON
READING
HAMILTON WENHAM
MANCHESTER
265
439
586
337
BEVERLY
ROUTE 128
WINCHESTER
OAK GROVE
PINES RIVER
982
94
2083
3330
2216
5546
MAINT. FACILITY
1078
7629
PORTER SQUARE
8707
NORTH STATION
(8707)
STATE STREET
SOUTH STATION
(≈2605)
2605
MAINT. FACILITY
BACK BAY
(≈1402)
4007
3381
2113
READVILLE
626
1268
717
1177
RIVERSIDE
ROUTE 128
ROUTE 128
CANTON JUNCTION
NEEDHAM JUNCTION
655
22
FRAMINGHAM
NEEDHAM HEIGHTS
NORFOLK
SHARON
CANTON
WORCESTER
FRANKLIN
ATTLEBORO
STOUGHTON


WHITE RIVER JUNCTION
LINCOLN
INTERVALE
PORTLAND
CONCORD
MANCHESTER
ROCKINGHAM
HAVERHILL
PORTSMOUTH
AYER
299
LOWELL
906
LAWRENCE
227
NEWBURYPORT
207
ROCKPORT
347
WEST CONCORD
BEDFORD
WOBURN
586
WILMINGTON
1470
READING
HAMILTON WENHAM
472
MANCHESTER
786
BEVERLY
ROUTE 128
94
WINCHESTER
3216
OAK GROVE
3330
PINES RIVER
2770
1283
6100
9316
MAINT. FACILITY
1377
PORTER SQUARE
10693
NORTH STATION
10693
STATE STREET
SOUTH STATION
≈ 3196
3196
MAINT. FACILITY
BACK BAY
≈ 1721
4917
4278
3010
READVILLE
639
RIVERSIDE
1268
ROUTE 128
811
1980
ROUTE 128
CANTON JUNCTION
NEEDHAM JUNCTION
1138
342
FRAMINGHAM
13
NEEDHAM HEIGHTS
NORFOLK
94
SHARON
483
CANTON
320
WORCESTER
FRANKLIN
ATTLEBORO
STOUGHTON

RAILROAD CONNECTION

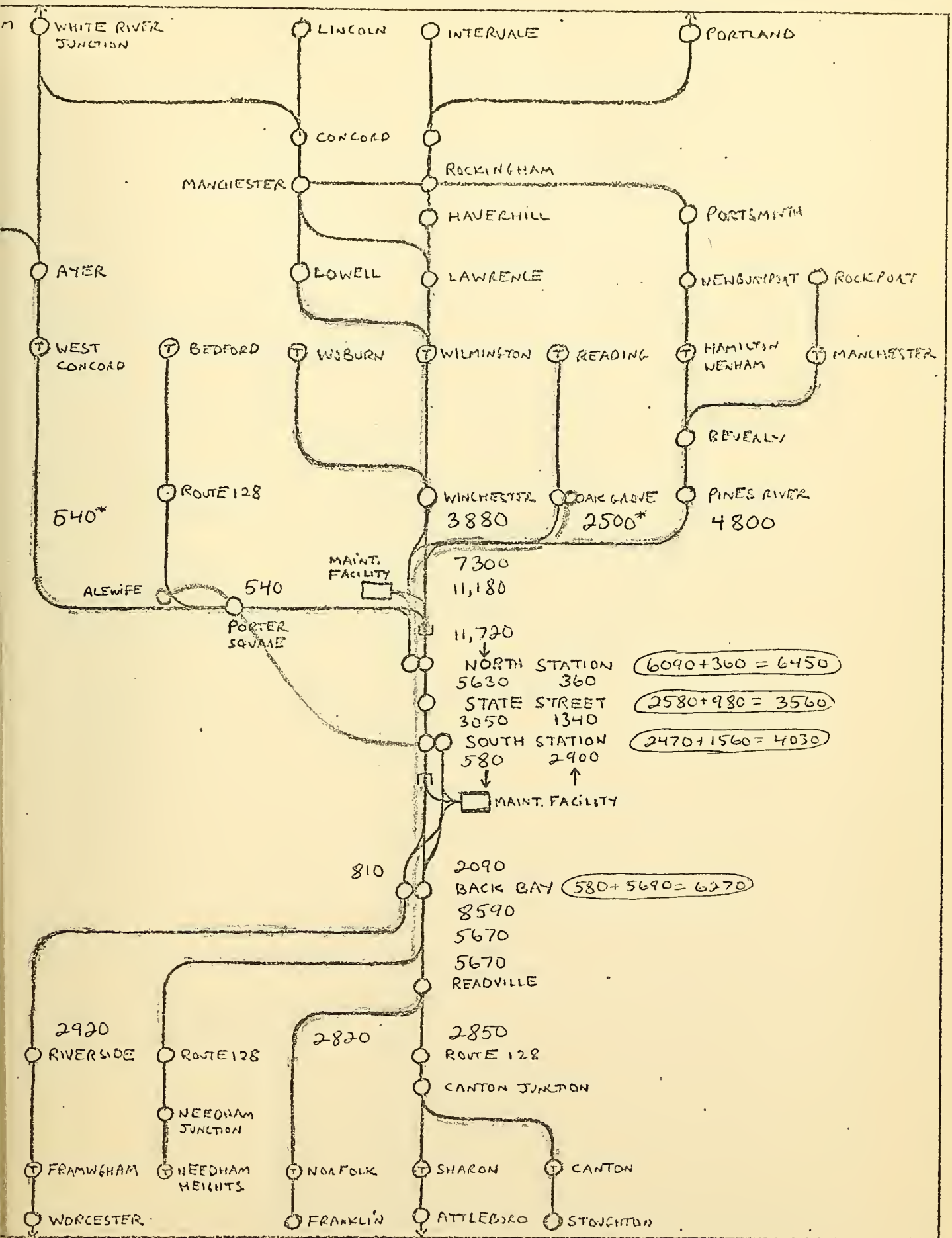
SYSTEM = 17,770

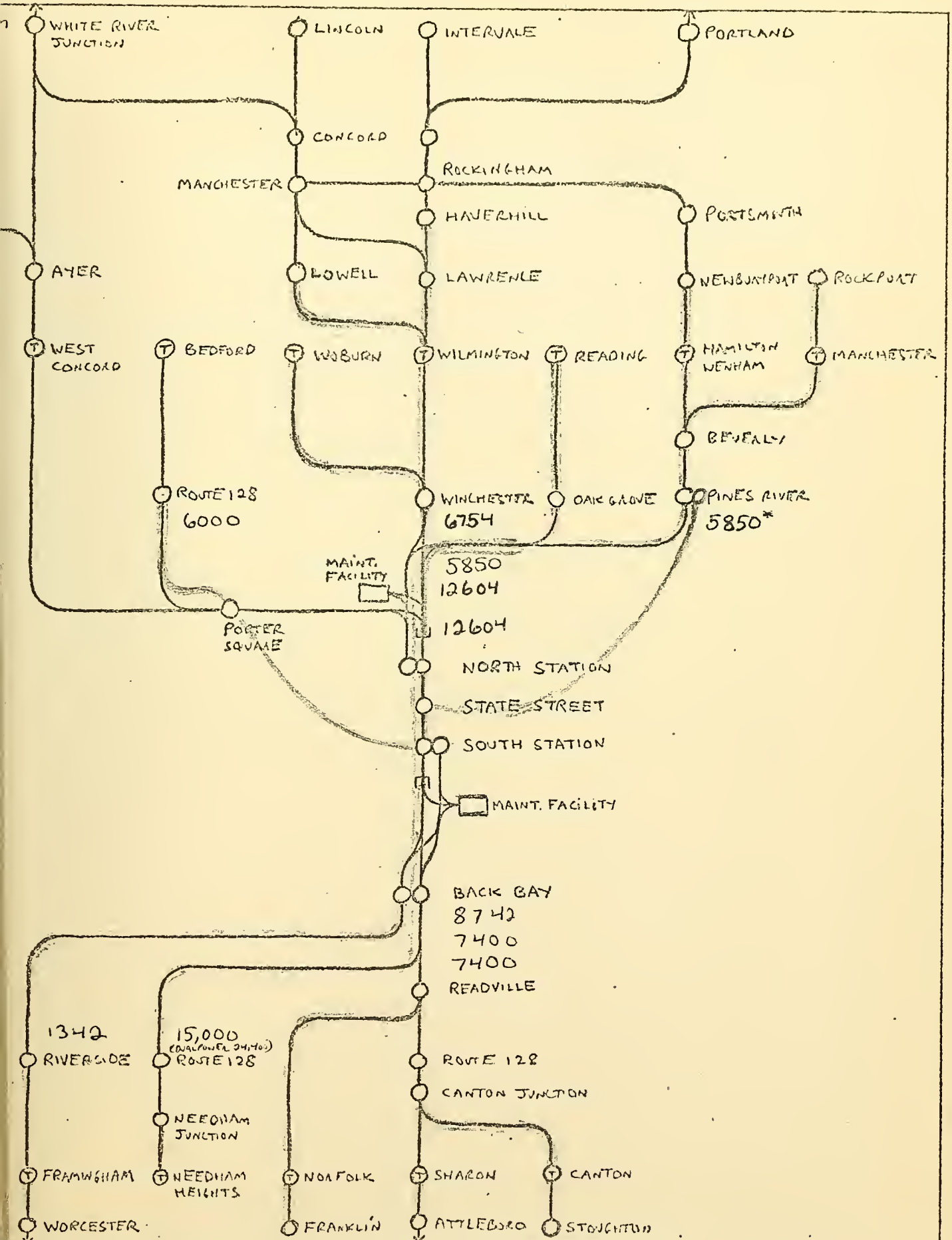


SIT EXTENDED TO OAK GROVE, ALEWIFE AND ROUTE 128 NEEDHAM ; EXPRESS BUSES TO BEDFORD (AND SUDBURY)

PASSENGERS VS. SOUTH STATION PASSENGERS ; SYSTEM ON MBTA AREA

ATEWAY INBOUND RIDERSHIP 1980 BTR MODERATE INVESTMENT NETWORK, UPGRADED COMMUTER RAIL
AILROAD CONNECTION
SYSTEM = 20,310

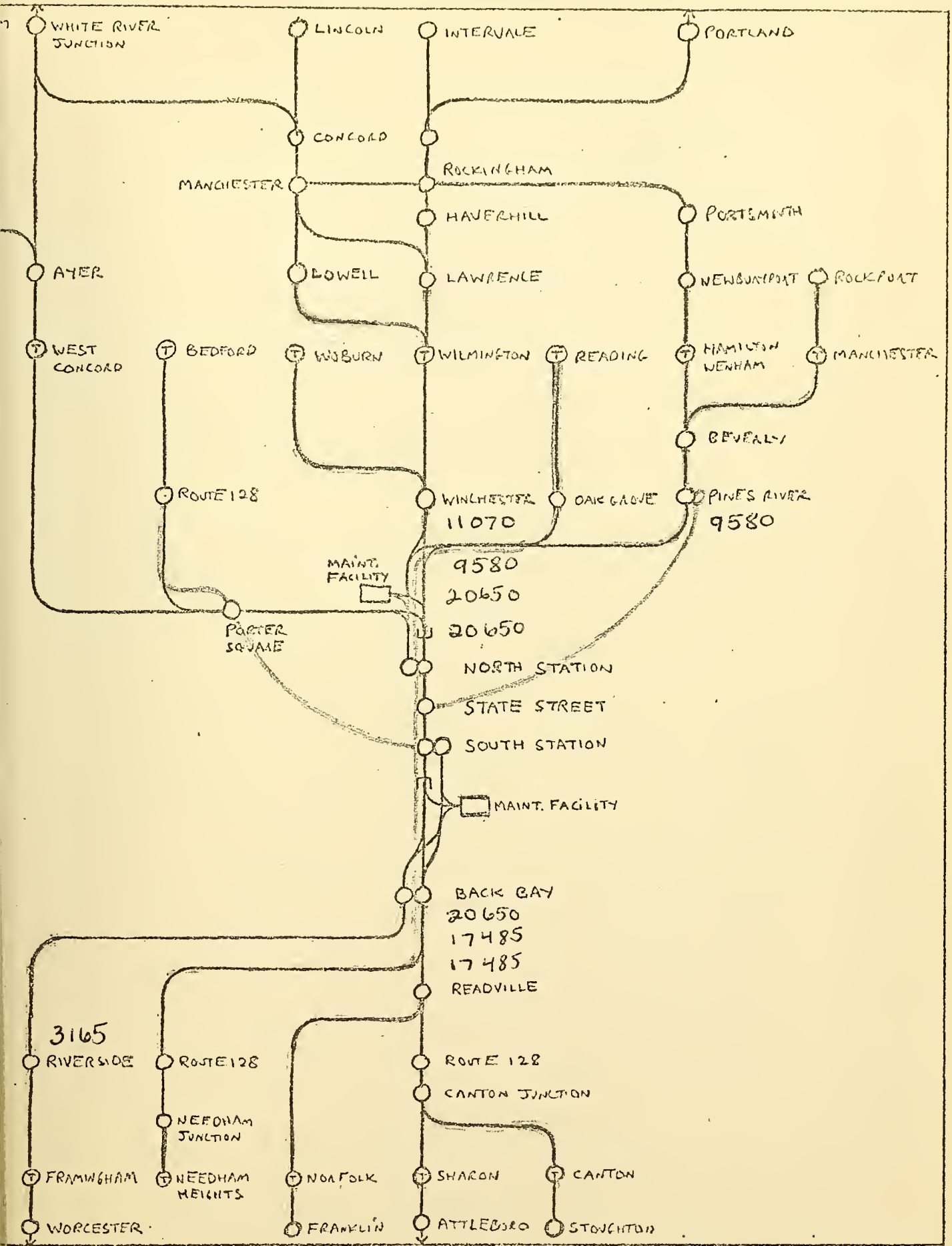




ST EXTENDED TO PINES RIVER, READING, ROUTE 128 LEXINGTON AND ROUTE 128 NEEDHAM

CHANGE IN THE MODAL SPLIT, EXISTING RATIO PEAK/DAILY RIDERSHIP

SYSTEM = 41,300



LE IS A COMMUTER RAIL CAR WITH ELECTRIC MOTORS, TAKING POWER FROM CATENARY
ETS RR BUFFING STRENGTH REQUIREMENTS (AS IT IS A RAILROAD CAR) AND HAS SUFFICIENT POWER TO WEIGHT
TO ACHIEVE 2.5→3.0 MPHPS ACCELERATION, VEHICLE SEATS 90 PASSENGERS, IS 85' LONG HAS DISABLE
DORS AT ALL 4 SIDES, HIGH/LOW LOADING, 6 CAR TRAINS, 3 MIN HEADWAYS

VARIOUS USER TYPE

COST / USER

~~COST/PEAK USER~~

			VEHICLES	PERSONS/CAR	PERSONS	NEW USERS
DEPRESSED ARTERY 6 LANES		TRUCKS 11%	22,220	1.2	26,664	———
		AUTOS 89%	179,780	1.5	269,670	———
		TOTAL 100%	202,000	—	296,334	———
		PEAK				
		COST = $355,000,000				
RANK =		COST/USER = $1195		COST/NEW USER → ∞		
RANK =		COST/PEAK USER = $		COST/NEW PEAK USER → ∞		
DEPRESSED ARTERY 8 LANES		COST = $622,000,000				
		COST/USER = $2095		COST/NEW USER → ∞		
		COST/PEAK USER =		COST/NEW PEAK USER → ∞		
SOUTH SHORE (1971) SEGT	FIRST YEAR	RIDERSHIP = 18,750		NEW = 8450	PEAK = 4410	
		COST = $75,000,000				
		COST/USER = $4000		COST/NEW USER = $8860		
		COST/PEAK USER = $17,000		COST/NEW PEAK USER = $		
SOUTH SHORE	1973 (NO-)	RIDERSHIP = 28,990		NEW = 13030	PEAK = 6810	
		COST = $75,000,000				
		COST/USER = $2590		COST/NEW USER = $5750		
		COST/PEAK USER = $11,000		COST/NEW PEAK USER =		
RAIL CONNECTION BTWN MOD. INVST.		RIDERSHIP = 40,620		NEW = 5080	PEAK = 21,200	
		COST = $106,000,000				
		COST/USER = $2610		COST/NEW USER = $20,850		
		COST/PEAK USER = $5000		COST/NEW PEAK USER =		
RAIL CONNECTION ELECTRIFIED COMMUTER MIL/MARIETTA.		RIDERSHIP = 42,692		NEW = 6230	PEAK = 22,300	
		COST = 106,000,000				
		COST/USER = $2490		COST/NEW USER = $17,000		
		COST/PEAK USER = $4750		COST/NEW PEAK USER =		

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

WFE
July 1974

12

TECHNICAL MEMO #12

Relationship of Depressed Artery to North Terminal Proposals

The North Terminal area extends from Leverett Circle and North Station to include I-93/Prison Point Bridge and the Mystic River Bridge in Charlestown. A draft EIS has been prepared to evaluate the probable impacts of 5 alternate proposals to deal with the operational and safety hazards to traffic movements in this area. A decision among these five schemes has been held until the resolution of the Central Artery Depression Feasibility Study which covers much of the same territory.

The major problems addressed by the North Terminal proposals are as follows:

1) Eliminating weave on Fitzgerald Expressway Bridge between Mystic Bridge-Leverett Circle versus Central Artery-I-93 movements.
2) Substandard geometry at north bound Mystic Bridge approach ramp.
3) Poor or missing on-off ramps for Mystic Bridge approaches.
4) Connecting Rutherford Avenue to Boston.
5) Improving City Square traffic patterns.
6) Improving Leverett Circle traffic patterns.

The alternatives evaluated respond in varying degrees to these problems:

Alternative A: No-build - do nothing at all except improve City Square traffic pattern.

Alternative B: Minimum build - connect relocated Rutherford Avenue to Boston across Charlestown Bridge and new Warren Avenue dam. Improve City Square.

The three build alternates: C, D, E put both directions of the relocated Rutherford Avenue on the Charlestown Bridge and rework City Square streets to accommodate this and the new river crossings they propose. They all rework Leverett Circle traffic patterns to suit the new connections. All three of these alternatives also improve the geometry of the Wapping Street ramps northbound on the Mystic Bridge.

Alternative C:

High Level Crossing - connect Mystic Bridge to reworked Leverett Circle directly by new twin bridges; maintain Artery I-93 connection via existing Fitzgerald Expressway Bridge. New on-off ramps for north and southbound Mystic Bridge approaches.

Alternative D:

Parallel Crossing - connect Mystic Bridge to Leverett Circle via new double deck viaduct parallel to existing Fitzgerald Expressway bridge on which Artery I-93 movement continues. Elevated connection to reworked Leverett Circle. New on-off ramps on northbound Mystic Bridge approach only.

Alternative E:

Low Level Crossing - connect Mystic Bridge to Leverett Circle via two low level viaducts across Warren Avenue Dam while Artery I-93 moves continue on existing Fitzgerald Expressway Bridge. At-grade or below-grade connection to reworked Leverett Circle. New on-off ramps on northbound Mystic Bridge approach only.

Compatibility

The proposals to depress the Central Artery fall into two categories: a) one which depresses as far as Salem Street in the North End and b) those which depress to Causeway Street at North Station.

By depressing the artery to Salem Street and then rising above North Washington, it is physically possible to connect the depression with the existing Fitzgerald Expressway bridge. This scheme is physically compatible with the North Terminal "build" alternatives, but it involves unacceptable operating conditions. The 3000 foot long 4% grade necessary to meet the existing viaduct would force trucks to creep speed and to make a slow speed weave across rapidly moving traffic to reach I-93 northbound.

The 6 or 8 lane schemes which depress the artery to Causeway Street address the same operational and safety problems as the North Terminal proposals. Moreover, the major functional difference between North Terminal alternatives C, D, E and the 6 and 8 lane alternatives of the depressed artery lies in the Leverett Circle/Mystic Bridge and Artery/I-93 connections. The North Terminal schemes provide new river crossings for the former and use the existing Fitzgerald Expressway bridge for the latter, while the 6 and 8 lane depressed artery schemes do precisely the reverse; the new river crossings are used for the Artery/I-93 moves and the existing Fitzgerald Expressway bridge for the Leverett/Mystic connection. The two sets of proposals are therefore basically incompatible. They cannot be connected; only one or the other can be built.

Leverett Circle

North Terminal schemes C, D E and the 6 and 8 lane depressed artery proposals rework Leverett Circle to reflect different connections either to the Artery/I-93 or to the Mystic Bridge.

North Terminal alternate C has a major negative impact on Leverett Circle and its surroundings. The depressed artery proposals require the removal and relocation of the MBTA Green Line Viaduct and Science Park station. North Terminal D & E have the fewest negative impacts in this area.

River Crossings:

The more river crossings there are and the more massive a visual barrier they become, the more difficult it is for pedestrians and drivers to remain aware of land form or the river. Orientation clues are lost and psychological accessibility to potential recreational uses of the waterfront is reduced. In short, the more river crossings, the less existing/potential amenities are available to resident and visitor.

Among the alternatives being compared North Terminal alternate C introduces the most jarring new river crossings. It opens a new transportation corridor and hides the river along its length.

Except for North Terminal alternates A and B, all the schemes being compared go through the proposed Paul Revere Landing Park at the Charlestown End of the new Warren Avenue Dam. All but alternate A make access to this Park and the Dam more hazardous and unpleasant than it is today.

North Terminal alternate B introduces no additional river crossing except a 2 lane breakdown viaduct across the new Warren Avenue Dam.

North Terminal alternate C adds 3 new river crossings. Two 2 lane and breakdown viaducts cut across the river diagonally and another 2 lane and breakdown viaduct goes across the new Warren Avenue Dam.

North Terminal alternate D adds 3 new river crossings. A new double deck viaduct (2 lanes and breakdown) parallels the existing Fitzgerald Expressway Bridge at a slightly lower elevation. Another viaduct (2 lanes and breakdown) goes across the new Warren Avenue Dam.

North Terminal alternate E introduces 2 new crossings. Both viaducts (each 2 lane and breakdown) run across the new Warren Avenue Dam.

Both the 6 lane and 8 lane alternatives proposed for the depression of the Central Artery follow the same alignments and differ only in the width of viaducts (3 lanes and breakdown vs. 4 lanes and breakdown). The northbound viaduct goes across the new dam and the southbound viaduct cuts across the river to the west and below the existing Fitzgerald Expressway Bridge.

On the basis of their impact of the criteria discussed above, the schemes being compared rank as follows:

Alt. A: no change	
Alt. B: minimum impact	1 viaduct
Alt. E: concentrates crossings	2 viaducts
6/8 Lane: new crossing less of a barrier	2 viaducts
Alt. D: new crossing increases barrier	3 viaducts
Alt. C: new corridor crossed	3 viaducts

City Square

The basic differences between North Terminal and depressed Artery proposals in City Square relate to A) Street patterns B) New viaducts C) the YMCA, and D) Accessibility to Expressways.

North Terminal schemes B, C, D, E provide a rotary exchange at ground level. The depressed artery schemes do not provide a ground level rotary.

North Terminal schemes C, D, E provide a new viaduct between the existing viaducts and the Court House but preserve the YMCA. Depressed artery schemes place a new viaduct between existing ramps and take the YMCA.

North Terminal schemes C, D E enable drivers an expressway connection from Charlestown to Leverett Circle whereas the depressed artery schemes do not allow this move.

Comparison of North Terminal versus depressed artery proposals in this area is moot. The physical depressed artery connections are less complex and obtrusive but curtail accessibility for Charlestown residents and remove the YMCA.

Navy Yard/Lowney Way

The differences between North Terminal and Depressed Artery proposals in this area relate chiefly to how on-off moves for northbound and southbound Mystic River Bridge traffic are accomplished.

North Terminal alternates A and B involve no changes to the existing situation.

North Terminal alternate C removes the Henley Street ramps and replaces them with scissors ramps on Lowney Way; this necessitates taking approximately 30 dwelling units and one small park. A set of scissors ramps is provided between the Navy Yard wall and the bridge viaduct for the northbound movement. Grade access to the Bridge northbound requires taking a portion of the Navy Yard for Chelsea Street.

North Terminal alternates D and E retain the Henley Street ramps and providing scissors ramps northbound exactly as in alternate C.

Depressed artery schemes retain the existing Henley Street ramps. They provide an exit to grade from the Northbound Bridge approach. Chelsea Street is reconnected to City Square by taking the SW corner of the Navy Yard, thus relieving Lowney Way.

The depressed artery connections provide the same degree of service as North Terminal schemes C, D E although some of the on-off ramps are

less conveniently located. North Terminal alternate C has the most severe impacts.

In general, there are no clear cut differences among North Terminal alternates D, E and the depressed artery proposals. The former provide slightly better service in Charlestown while the latter have generally less severe impacts.

As a matter of policy, the Commissioner of DPW has ruled out the new high-level Leverett Circle Bridge.

The remaining options all present problems to Charlestown - even the "no-build" North Terminal because although there are no new viaducts or ramps, there will be much more street traffic in City Square than with some of the other schemes.

Whether major reconstruction and depression of the I-95/I-93 Interchange in City Square is feasible to solve the traffic problems more acceptably must be an element of an EIS on the depressed Artery.

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

BJECT

TECHNICAL MEMO #13 #13

History of the Central Artery

..."A complete system of expressways to serve the entire area forms the backbone of the recommended solution to Metropolitan Boston's complex traffic problems"...

Master Highway Plan 1948 for the
Boston Metropolitan Area

Within this frame, the concept of the present Central Artery was refined, designed and finally constructed. It was believed that this new, limited-access, north-south route would afford relief to the congestion on surface streets, which had begun to develop due to the rise in popularity of motor vehicle use and the growth of the region. The proposed "thoroughfare" was also envisioned to become a generator of economic development in outlying and intown districts while benefiting users through savings in travel time and distance.

←The 1930 Report on a Thoroughfare Plan for Boston described the proposed roadway as follows: "Central Artery. A new two level street from Nashua Street to the northern terminus of proposed Blue Hills Radial at Kneeland and Albany Streets."

This report also envisioned the new expressway as an attractor to "through trips" which were then forced to detour through the city streets.

As part of the Central Artery, there was featured an upper level roadway which was to extend from the North Station at Nashua Street to the Dover Bridge. At Kneeland Street it was designed to connect to the proposed Blue Hills Radial and continue southward to join with the Old Colony Parkway via the Dover Street Bridge. A system of ramps would offer access to major downtown cross streets. It was envisioned that

the roadway would not only serve as a direct north-south route but would also serve traffic having an origin or destination within the Central District.

Study of the proposed Central Artery continued until in 1948 a joint board submitted to Governor Bradford the Master Highway Plan for the Boston Metropolitan Area. Based upon extensive traffic surveys, a significant feature of the report was the series of expressways designed to relieve Boston's traffic problems. The proposed Central Artery which appears in that Master Plan was to be the closest of any previous studies in defining its present limits, design and location.

In 1949, the General Court authorized a $100 million bond issue for Massachusetts highway construction; of the $92 million available to the DPW, only $37 million could be spent in Metropolitan Boston. The then Commissioner of Public Works, William F. Callahan, determined that a major portion of these monies should be spent in the construction of the Boston Central Artery. The engineering firms of Charles A. Maguire and Associates and Fay, Spofford and Thorndike were retained to design the first section.

The Artery was to be studied and constructed in two sections: I-extending from the Charles River near North Station to Fulton Street with intermediate connections; II-from Fulton Street to Fort Hill Square. Not until 1953 were final decisions made on a design and a location of the extension beyond Fort Hill Square to Dover Street.

A project of such size had quite an impact in the metropolitan area not only in engineering and construction terms but also in integrating the various viewpoints on related land use, displacements, relocation, economic and design aspects.

Naturally such roadway construction would necessitate the displacement of some homes, businesses and recreational areas. While relieving traffic congestion would enhance a city's livability, any family or business displacements would invoke hardship. Although documentation on housing displacement is not readily available, it is known that the construction of the Central Artery displaced 573 business firms which employed 7,160 persons. Eighty percent of all businesses displaced survived in their new locations which accounted for 90% of these employees. The consensus among these businesses concerning their survival was that had assistance in moving, finding relocation sites, professional and legal advice been greater, survival among displaced businesses would have been higher.

The prime functional consideration in the design of the Artery was to supply the city with a collector-distributor roadway for vehicular traffic while the expedition of through traffic was of a secondary consequence. Location of the roadway as close as possible to prime origin and destination points in the downtown with frequent entrance and exit points would serve this prime function.

The North End business community pressured for relocation of the downtown portion of the Artery to the northerly edge of the city along Commercial Street and Atlantic Avenue. The fundamental reason why this change was not made was that it was felt that such a location would not provide ramp service at points most desirable for the collection and distribution of traffic. The accompanying increase in construction cost, land takings, displacement and property damages supported the refusal to relocate.

In considering the economic aspects of building such a roadway, it was anticipated that because of long range benefits to motorists and other taxpayers in travel time saved, safety, business increase and the rise in property values that the roadway should be built. Funds available for its construction were obtained after numerous efforts. Maintenance and operating costs were expected to be covered through state funds via gasoline taxes, vehicle registration fees and other usual sources of highway revenue.

After numerous preliminary engineering studies, the present design of the Central Artery was derived. It was then believed to be the best type of structure possible considering land, foundations, spans, clearances, functional and economic constraints.

Construction of the Artery was in two stages: the intown, elevated portion was announced in 1950 and completed four years later. Controversy over location of the underground portion delayed its completion until 1959 when the tunnel section was opened. It was finally designed to surface at Kneeland Street, and rise to a crossing of Broadway before meeting the present Southeast Expressway.

The 1948 Master Plan originally intended that the Central Artery would become a segment of the Belt Route designed to encircle the entire downtown area. There was proposed to be seven other expressways with connections to this route: Southeast Expressway; Southwest Expressway; Western Expressway; Northwest Expressway; Northern Expressway; Northeast Expressway; and East Boston Expressway. The Belt Route with numerous connections to major radial streets and highways would serve a double purpose: a by-pass of the central area and accommodation for crosstown and local traffic. This concept was later amended when the Belt system

was viewed mainly as a distributor highway to serve vehicles destined for downtown Boston.

The final location and design of the Boston Central Artery was very close to that described in the 1948 Master Highway Plan. Although some of the earlier proposed circumferential highway system (Inner Belt, Southwest Expressway) were never to be reality, the Southeast and Northeast Expressways were eventually constructed and became connecting roadways to the Central Artery.

Audrey McAllister
July 9, 1974

History of Central Artery - Reference Sources

Charles A. Maguire and Associates and Fay, Spoffard and Thorndike. The John F. Fitzgerald Expressway - Report on Location Studies Kneeland Street to Vicinity of Southampton Street. April, 1955

The City Planning Board. Report on a Thoroughfare Plan for Boston. Boston, Mass. 1930

Greater Boston Economic Study Committee. Business Relocation caused by the Boston Central Artery. April, 1960

Joint Board for the Metropolitan Master Highway Plan. The Master Highway Plan for the Boston Metropolitan Area. February, 1948.

Mass D.P.W. The John F. Fitzgerald Expressway. Location and Importance of the Central Artery from Fort Hill Square to the Vicinity of Dover Street, Boston. November, 1953

Wilbur, J. B. and Keane, E. C. "The Boston Central Artery," Journal of the BSCE, Vol. 40, No. 4, October, 1953 pp. 295-311

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

CENTRAL ARTERY FEASIBILITY STUDY

Community Liaison & Technical Assistance

Boston City Hall
Room No. 941

(617)-722-4473

TECHNICAL ASSISTANCE PRIMER #1

A QUICK REVIEW OF HISTORIC PRESERVATION AND

ENVIRONMENTAL LAWS AFFECTING TRANSPORTATION PROJECTS

FUNDED WITH FEDERAL ASSISTANCE

The purpose of this paper is to provide the reader with a basic understanding of how Federal environmental and historic preservation laws affect the transportation planning process. Although the scope of some of these laws encompasses much more than just transportation projects, in this discussion their influence will be discussed only in the context of transportation projects. This paper is not intended to be a definitive legal review of the subject, but rather a basic guide for the layman to some of the issues and requirements that must be addressed.

There are three major Federal laws that require administrative review of proposed actions of public agencies when these actions involve expenditure of Federal funds. Briefly, they are as follows:

(1) Section 102(2) (c) of the National Enviromental Policy Act of 1969 (NEPA). This is the law that requires a Federal agency to file an Environmental Impact Statement (EIS) on any proposed action that significantly affects the environment. The purpose of the EIS is to provide decision makers with a detailed assessment of the total environmental costs and benefits of a proposed project, before funds are committed for construction of the project. "Environment" is meant to be interpreted here in the broadest possible sense; it is not meant to be construed exclusively as forested areas and wildlife. For example, proposed alterations to the existing Central Artery in downtown Boston could have major environmental consequences, both positive and negative, by their effects on the economic, social,

cultural and physical well-being of the general area and of the abutting and proximate neighbors of the Artery.

The Federal agency proposing an action must show how its proposed action will change the existing environment; what adverse effects and irreversible commitment of resources will occur as a result of the project; the relationship between the short-term uses of the environment and the maintenance and enhancement of long-term productivity; and the alternatives to the proposed action that are being considered, including the alternative of not doing the project. In essence, the Environmental Impact Statement must describe how a proposed project will change the existing surroundings of the project area.

In the case of a proposed section of the Interstate Highway System (which would include construction of a depressed Central Artery), the U.S. Department of Transportation (DOT) is responsible for preparing the Environmental Impact Statement. For highway projects, it is normal procedure for DOT to delegate this responsibility to the State highway agency (here, the Massachusetts Department of Public Works). The State highway agency prepares the EIS for DOT. DOT, in turn, submits it through appropriate federal channels.

(2) Section 4(f) of the Department of Transportation Act of 1966, as amended. This section of the DOT Act:

> "... permits the Secretary of Transportation to approve a program or project which requires the use of publicly owned land from a park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or land from an historic site of national, State, or local significance as so determined by such officials only if:
>
> "(1) there is no feasible and prudent alternative to the use of such land, and
>
> (2) such program includes all possible planning

to minimize harm to the Section 4(f) land resulting from such use."

This section of the DOT Act (commonly referred to as just 4(f)) came into being as a result of several nationwide controversies over routing of planned Interstate Highways through parklands. Until the enactment of this statute, not only were parklands not given any special protection in planning highway alignments, but often routings through parklands were encouraged, since they involved a minimum of right-of-way acquisition cost and difficulty.

Several court tests of the law, especially the landmark case, "Citizens to Preserve Overton Park v. Volpe", have determined that the law is to be interpreted strictly and literally. Parklands are now afforded a special protection, and a project may not be built through these lands unless a "... feasible and prudent..." alternative exists. The courts have defined a "... feasible and prudent alternative..." to mean an alternative that can be built (in the engineering sense); the additional cost of such an alternative or the policy preferences of the state agency involved are not allowed to be traded off against the objective of preserving parkland, which is to be considered of paramount importance. If there is a feasible and prudent alternative to the proposed project, the project may not be built. If there is no feasible and prudent alternative (including the "no build" option), the law states the project or program may not be implemented unless "... such program includes all possible planning to minimize harm to the Section 4(f) land resulting from such use." As stated above, court interpretation of the law have made it clear that critically important natural and historic resources have a special protected status; they may not be impacted without exceptional cause.

The enactment of Section 4(f) of the DOT Act changed many of the basic groundrules and operating assumptions of State transportation agencies. In the past, transportation departments, like many other project-oriented public agencies tended to externalize most of the concomitant impacts of their projects and programs by concentrating on user bene-

fits. Section 4(f) and several other laws forced highway departments to look beyond transportation objectives and recognize other community objectives in planning their programs and projects.

Although the Section 4(f) Review and the Environmental Impact Statement (EIS) are related in concept and deal with the same substantive issues, there are significant differences between the two. They are as follows:

(A) Scope - The EIS deals with the environment in the broadest possible sense. It requires a careful analysis of the project as a whole - but no specific findings are required. Section 4(f) deals with a specific subset of the environment. It requires specific administrative and analytical actions on the subset of the environment that qualifies for this protection under the provisions of Section 4(f).

(B) Flexibility - The EIS deals with a broad range of competing interests -- it is discretionary, allowing a broad range of positive and negative impacts of a project to be weighed. Section 4(f) is prohibitory -- it forbids certain actions, except under severely mitigating circumstances; it places the burden of proof and justification for the project on the proposing agency.

For example, in an EIS for a new highway, the costs (both monetary and social) of relocating homes and businesses may be weighed against the transportation gains from the project for several alternatives. In a Section 4(f) review, however, the cost of taking parkland for a highway may not be traded off against improved transportation service unless no other feasible alternative exists.

(3) Section 106 of the National Historic Preservation Act of 1966, and others. This law affords special protection to properties that are listed in or are eligible for listing in the National Register of Historic Places (NRHP). The Federal agency (eg. the U.S. Department of Transportation in the case of a highway) proposing a project is obligated

to identify any NRHP properties on which the project might have an effect. "Effect" is defined as "... when any condition of the undertaking causes or may cause any change, beneficial or adverse, in the quality of the historical, architectural, archeological or cultural character that qualifies the property under the National Register Criteria." The Federal agency proposing the project must consult with the State Historic Preservation Office (here, the Massachusetts Historical Commission) to determine whether the effect of the project on the NRHP property is adverse. If both groups can agree that the effect is not adverse, documentation of the project is sent to the Executive Director of the Advisory Council on Historic Preservation for review. If the effect is determined to be adverse, a formalized review procedure has been established, which includes preparation of a preliminary case report, and initiation of a consultation process.

Some projects that require an Environmental Impact Statement also impact NRHP sites. Even though the two processes have separate, binding requirements, under ordinary circumstances both reviews will be done within the EIS document.

The Advisory Council on Historic Preservation also has the power to recommend measures regarding a non-Federally funded project, when the project affects a NRHP property. This action may be initiated "... (1) upon request from the President of the United States, the President of the U.S. Senate, or the Speaker of the House of Representatives (2) when agreed upon by a majority vote of the members of the Council."

SUMMARY

This brief memo has attempted to review quickly some of the pertinent Federal laws that provide for review of transportation projects. Obviously, it was not possible to present a thorough, detailed description of these topics and all their ramifications. Further information regarding any of these topics can be obtained from the Community Liaison and Technical Assistance Office of the Central Artery Study.

INTER-OFFICE COMMUNICATION

TO

FROM

DATE

SUBJECT

CENTRAL ARTERY FEASIBILITY STUDY

Community Liaison & Technical Assistance

Boston City Hall
Room No. 941

(617)·722·4473

#14
15

MEMORANDUM

TO: Central Artery Study Staff

FROM: Jim Brennan, Community Liaison and Technical Assistance

SUBJECT: Cross-Boston Tunnel, Proposed by Arthur Hall

DATE: July 17, 1974

A proposal has been received from Mr. Arthur Hall regarding an alternative to the present schemes being considered for depressing the Artery. The text of Mr. Hall's proposal is reproduced as follows. (Scheme is illustrated in Figure 1.)

"Features of Alternative:

1. Deep bore tunnel between North Station and Mass. Pike Interchange. 3-4 lanes plus breakdown each direction.
2. Depressed connector North Station to harbor tunnels. 2 lanes plus breakdown each direction.
3. Surface artery N. Washington Street to Summer Street, dropping into shortened Dewey Square tunnel for connection to expressway. 2 lanes plus parking each direction. Surface artery could be partially or fully depressed to pass below the Walk to the Sea.

"Factors to Consider:

1. Length of proposed cross-Boston tunnel is approximately equal to Sumner/Callahan.
2. Increased cost of deep bore tunneling would be partially or fully offset by reduced cost of temporary facilities and utility relocation.
3. Natural grade of the land along the proposed route would reduce the depth to which the tunnel had to drop.

"Advantages:

1. Eliminate complex phasing and need for temporary viaducts, permits construction of new facility before removal of old.
2. Eliminate on/off ramps along present Artery corridor, permitting reunification of cross streets.
3. Require less time to construct.
4. Require less interference with utilities.
5. Isolate construction activities at two locations, reduces disruption of the rest of the city.
6. Permit immediate development of vacant lands adjacent to the Artery.
7. Maintains existing level of traffic service during construction.
8. Northern portal and interchange could be designed to take Boston Garden, providing funds for a new sports complex.
9. Provisions could be included for partial recreation of Haymarket Square to give North End a node.

"Disadvantages:

1. Possibly increases difficulty in making rail link
2. Potential grade problems at North Station
3. Might interfere with or require taking of Rehabilitation Hospital.
4. Require relocation of rail lines
5. Require complex interchanges in small area
6. Require 'local traffic' to travel several extra blocks before entering expressway."

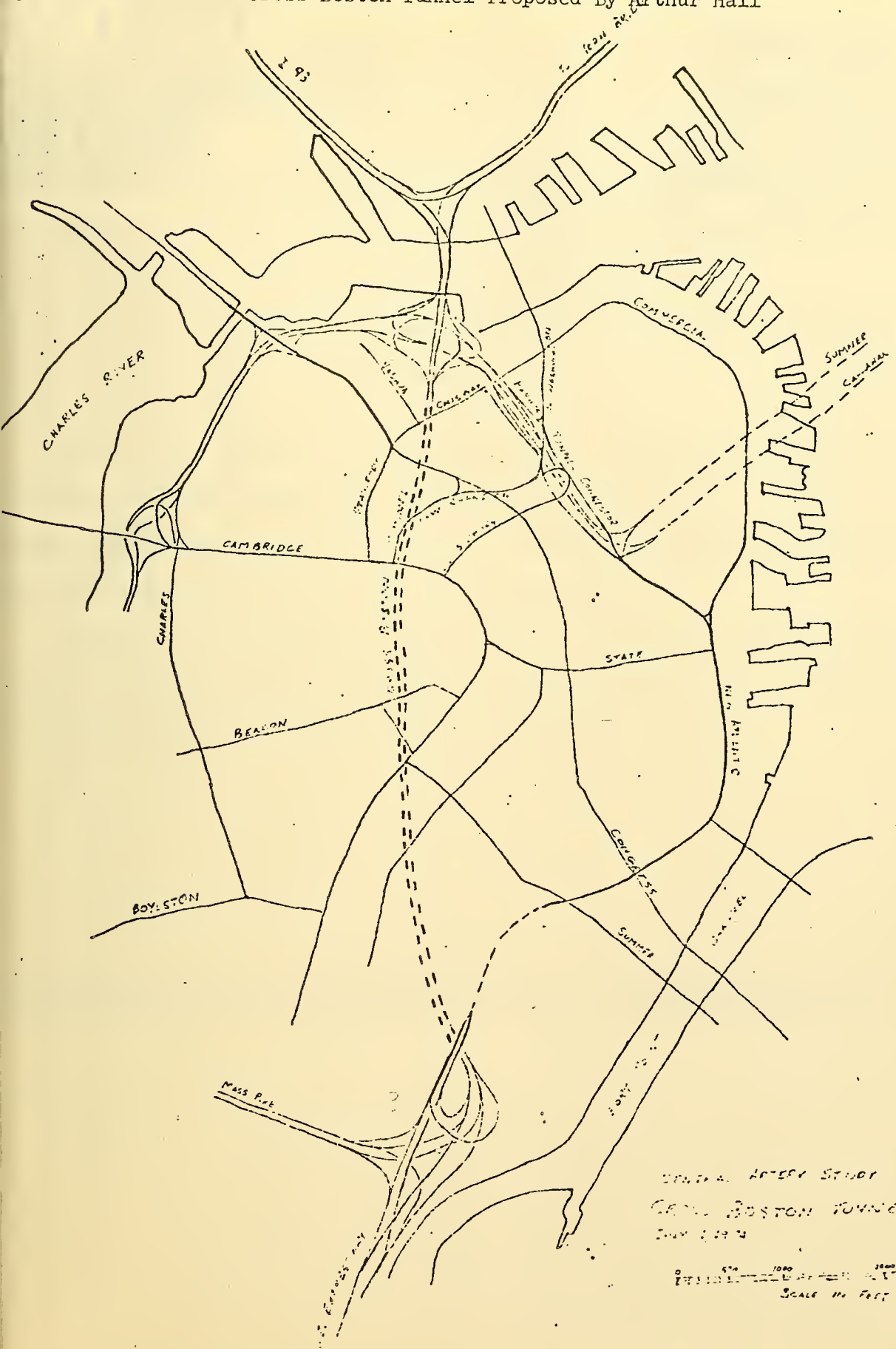
A preliminary examination of the features of this proposal by members of the Community Liaison and Technical Assistance staff has raised some points regarding this proposal. They are as follows:

- o A 'quick and dirty' estimate of the cost of a Massachusetts Turnpike to North Station tunnel would be roughly $700 million. This does not include the cost of an interchange in the North Station area, a tunnel from North Station to the Callahan/Sumner tunnels, or any demolition or new construction in the present Central Artery corridor.
- o Conceptually, this proposal is quite similar to the'island hopper' and harbor bypass tunnels that have been proposed in the part. Such proposals have been criticized because they do not take into account the primary function of the Artery--namely, acting as a downtown collection and distribution facility However, this proposal does recognize and deals with the Artery's other major function--that of a collector and distributor of Callahan and Sumner tunnel traffic.
- o It is questionable whether a high-type arterial from North Washington Street to Summer Street could accomodate enough traffic to act in lieu of the Artery as a downtown collector and distributor. Regardless of whether or not such a facility would have the capacity to accomodate the necessary collection and distribution activity, it is doubtful that neighboring communities would look favorably upon a surface-oriented highway proposal tha would tend to increase traffic in their neighborhoods. Discouragement of traffic in residential areas has been one of the primary objectives of neighborhood groups who have participated in the study.
- o It appears that the configuration of tunnel access roadways via the North Station area would significantly increase the amount of vehicle miles of travel in the downtown area. This may have serious implications vis-a-vis implementation of the EPA downtown traffic controls to reduce air pollution.
- o As Mr. Hall mentions in his proposal, there would be serious problems with grade in the North Station area. A deep bore tunnel coming north across downtown would be at least 60-70 feet below street level. The roadway would then have to rise up to make a 40 foot vertical clearance over the Charles River Dam. It appears that such a transition of grade could be made only through a multi-tiered interchange in the North Station area.
- o It is not clear where in the downtown area it might be possible to locate the structures necessary to provide ventilatio for a cross-Boston tunnel.
- o The projection of costs and construction schedules for deep bore tunneling tends to be difficult since variations in subsurface conditions often present construction difficulties that are not readily apparent before work commences.
- o Due to the technical complexity of this proposal, it is not possible to evaluate it fully and properly within this study. However, any further effor

to examine a depression of the Central Artery should examine this proposal and its ramifications in detail.

FIGURE 1

Cross-Boston Tunnel Proposed By Arthur Hall



CENTRAL ARTERY FEASIBILITY STUDY

Community Liaison & Technical Assistance

Boston City Hall
Room No. 941

(617)·722·4473

TO: Central Artery Study Staff, Working Committee and Interested Participants

FROM: Jim Brennan, Community Liaison and Technical Assistance

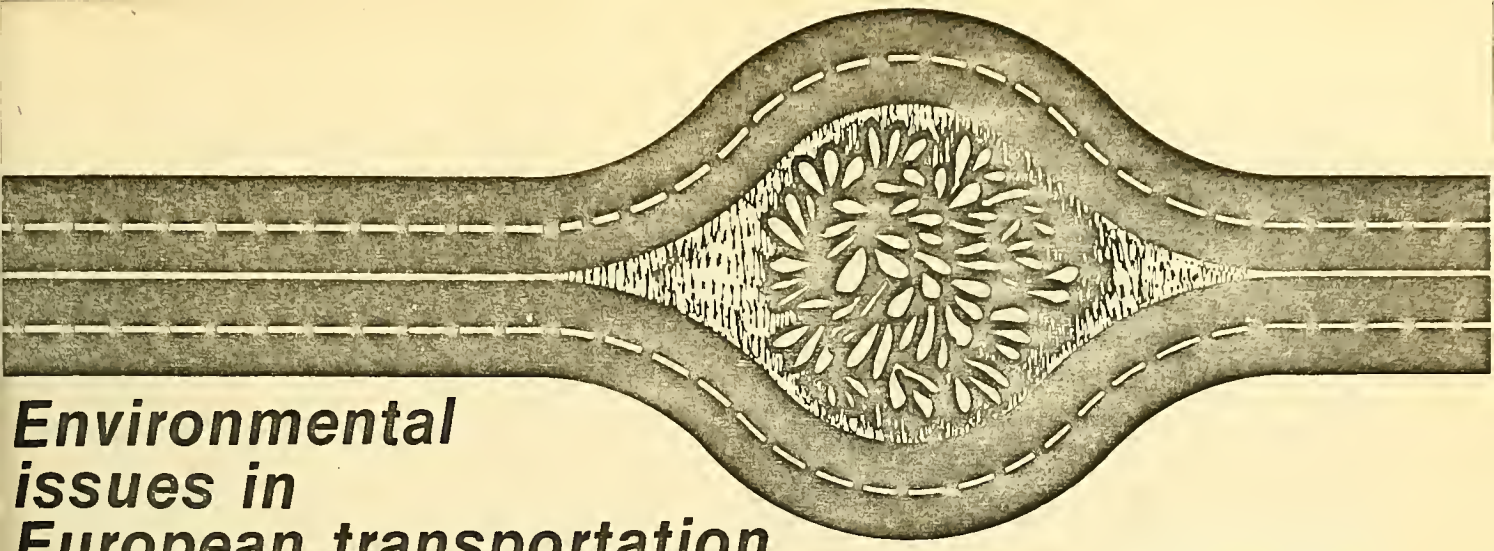
SUBJECT: Article Attached: "Environmental Issues in European Transportation"

DATE: July 22, 1974

Although the title of the attached article is somewhat misleading, since the article is neither exclusively environmental nor European in its focus, it is highly recommended for your reading. It is one of the better overview papers on the state-of-the-art in transportation planning today.

Focusing on the formulation and evaluation of projects, and the subsequent decision making process, it provides a good perspective on where we have been and where we are going in transportation planning.

"Environmental Issues in European Transportation", Planning Magazine, June, 1974. American Society of Planning Officials, Chicago. Reproduced by permission.



Environmental issues in European transportation

By C. Kenneth Orski

No one who travels extensively in Europe these days can fail to be impressed by the tremendous improvement in the level and quality of transportation service which has occurred over the last quarter century. A dense network of waterways, rail lines, air routes, roads, and superhighways covers the continent from the northernmost reaches of Scandinavia to the shores of the Mediterranean. The individual traveler and shipper has a wide range of transportation means from which to choose. Whereas once only a handful of locations enjoyed economic advantage by virtue of their superior accessibility, now this advantage has been nearly erased; today, a company seeking a new location has a choice of literally thousands of acceptable sites. It can select among regions, among metropolitan and nonmetropolitan locations within each region, and among diverse sites within each urban area. For many companies the Ruhr or the Randstad may no longer offer a significant geographic advantage over the Piedmont or the Midlands. Europe has truly become welded by its transportation lines into one integrated marketplace.

This means that the century-old task of building Europe's transportation system is virtually accomplished. To be sure, there are still large uncompleted stretches in the motorway network. There is scope for improving air connections between smaller cities. And there probably are still some regions in Europe which by today's standards could be considered inaccessible. But all these unfinished tasks represent only marginal improvements to the existing system. The basic job of providing Europe with a transportation network is essentially completed.

And so, as the age-old dream of abolishing geographic isolation approaches, priorities in the field of transportation change. The initial challenge was to make all places accessible to all others with the aim of promoting economic growth and providing opportunity for regional development. With this goal substantially achieved, attention is shifting to other objectives. One of the new objectives is to meet the rising expectations of the transportation user for a higher standard of service: greater convenience, shorter travel times, more comfortable journeys. Another objective is to spread the benefits of modern transportation more widely, to make them available to those who do not yet enjoy them. A third objective is to reconcile the public demand for ever-greater mobility and transportation convenience with the dual constraints of diminishing land and energy resources and heightened environmental and social concerns.

This third objective in particular has come lately to dominate our thinking about transportation. Conservation of energy, reduction of pollution and noise, preservation of the countryside, protection of ecologically fragile areas—all that which has come to be called loosely "environmental concerns"—have now not only become a subject of serious research within the academic community, but also enter increasingly into the calculations of practicing transportation planners, designers, administrators, and political decision makers.

What is new is the manner in which new transportation developments are being appraised. Gone is the emphasis of even a few years ago on capital costs, profitability, engineering efficiency, and user benefits. Today, attention is focused instead on those effects of transportation technologies which are likely to impinge on the wider public: the external effects.

This new emphasis merely reflects the changing ground rules under which present-day transportation decisions are being reached. Let me indicate more precisely what I mean by the changing ground rules and discuss some of their implications.

Who Pays? Who Benefits?

In the past, when considering the construction of a new airport or highway or mass transit system, alternative sites or routes were evaluated solely in terms of the anticipated benefits to operators and users of the facility, such as increased passenger and freight capacity, reduced travel and shipping time, and relief of congestion. In other words, the project was appraised only against criteria that were internal to the transportation system itself.

We now have come to realize that this is an incomplete way to view a public investment; the impact of the proposed project on the larger system to which it belongs deserves equal consideration. It has become the accepted practice, therefore, to try to anticipate the effects of location decisions on a host of external factors, such as future land development around the facility; the likelihood of attracting new industry and creating new demand for labor in the area; the levels of noise, pollution, and traffic congestion in neighboring communities; the increased burden on such local public services as electric power and

Kenneth Orski is director of the division of urban affairs in the Environment Directorate of the Organization for Economic Cooperation and Development, Paris. This article is taken from a speech he gave last September to the Symposium on the Environment and Transport Technology, Loughborough University, Loughborough, England.

OECD surveys auto usage

The Organization for Economic Cooperation and Development will survey 350 cities in Europe, North America, Japan, and Australia to learn ways to cut automobile usage. The OECD study will focus on improved mass transit concepts and other ways to conserve the environment and gasoline. Innovations which will receive special scrutiny are parking restrictions in congested areas, car-free zones, preferential treatment of buses and other mass transit vehicles on public highways, and improvements in the speed, comfort, and regularity of mass transit vehicles. The information gathered during the project will be examined at an OECD conference later this year.

sewage disposal; the degree of displacement and relocation assistance required; the desired economic development of the region; and the possible destruction of irretrievable resources, such as historic monuments, farmland, wildlife refuges, and open space.

The heightened awareness of the external effects of transportation decisions has subtly modified the assessment of transportation effectiveness. Today the best design for a transportation system is no longer necessarily the one that results in the lowest capital costs or the lowest user costs or the biggest reduction in travel time. Rather, it is that design which yields the highest social return on the investment and reconciles most effectively the conflicting concerns of the various groups and interests affected by the proposed project. The cardinal objective for the planner and designer, therefore, is no longer maximum functional efficiency, but, rather, the establishment of a community consensus on a course of action that respects the interests of both users and nonusers.

The new ground rules pose a difficult challenge to the professional. He is no longer free, as in the past, simply to identify a few technically promising alternatives, assess their costs and benefits, and recommend a course of action. This model of the professional working in splendid isolation is no longer acceptable to broad segments of the public as a basis for reaching decisions about large-scale public projects. Today the planner must formulate a much wider range of alternatives, including the option of not constructing the new facility at all. He must then identify all the social, economic, and environmental effects of any alternatives that the public thinks significant, whether or not these effects are readily quantifiable; and he must assure full opportunity for public involvement so that every group which may be affected has an opportunity to present its views.

He will also encounter greater problems of evaluation. For while some environmental impacts, such as energy consumption, are readily quantifiable, many other external effects are not. What value can be assigned, for example, to the consequences of severing a community by a motorway? What is the cost of a life wiped out in a highway crash or of reduced life expectancy due to polluted air? What kind of value system does one employ to describe the destruction of an old church or wildlife refuge by a new airport? These questions are not new. What is new is the demand of the general public and lawmakers that these unquantifiable effects of transportation be integrated into the decision-making process. This casts the transportation professional in a new and unfamiliar role for which he is often ill prepared—that of social advocate. For even if monetary or other "objective" values could be assigned to the external impacts of transportation decisions, there would remain the question of the ethical justification for imposing serious hardship upon an unwilling minority for the benefit of a much larger majority. In an admirable essay, "The Price of Posterity," Colin Buchanan, commenting on the Greater London Council motorway plan, stated the dilemma in these words: "What is the ethics of asking, indeed compelling, 30,000 people to render a serious sacrifice for the benefit of the other seven and a half million? This is the question which nags at the back of my mind. I have no real doubts about the need for the motorways nor about the economic and environmental benefits they could be made to yield. . . . But I am not clear about the morality of achieving these gains for the majority at the expense of a minority which may be very small in relation to the total population but is nevertheless a sizeable number of people. We do our cost-benefit analyses in hard economic terms, but it seems to me that there is some kind of ethical cost-benefit analysis which has escaped attention so far."

One could go on with other illustrations of this dilemma. What is the justification for exposing the residents of a community adjoining an airport to serious annoyance for the benefit of air travelers from distant places? What is the ethics of disrupting an urban neighborhood by building an expressway through it so that affluent suburbanites may commute in greater comfort and at higher speeds to their downtown offices? The traditional response has been that one should try to discern "the public interest." But more often than not "the public interest" has been identified as the interest of the majority, a response which begged the question. In these days of increasing pluralism and sharpened sensitivity to the rights of minorities we have come to acknowledge that there is no overriding public interest, but rather a multiplicity of interests: the interests of the user, of the transportation system operator, of those directly exposed to the undesirable effects, of the community at large—and perhaps the interests of generations yet unborn. Each of these publics has its own set of values, preferences, and ideas as to how the benefits should be paid for and distributed. Each of them demands a different allocation of benefits and costs, a different distribution of equities.

And so, however foreign to his nature and training he may find the role, the transportation planner cannot avoid being cast as a political actor. For in this field, abounding as it does with competing interests and conflicting objectives, there are no technically correct solutions, only politically viable solutions. The job of the transportation professional is necessarily one of interpreter and moderator of the demands of many publics, referee in a settlement dispute, and advocate in a court of equity. He must assess the different benefits and hardships of each alternative, identify the diverse groups upon whom these various impacts will fall, and examine ways in which those adversely affected can be compensated. In general, he must assist in the process of negotiation that always precedes the achievement of any effective political compromise. Of course, as Melvin Webber put it so well, "Those sorts of analyses and informational contributions cannot be politically neutral. Inevitably whenever the analyst must select data or interpretations he adds to the debate; and if they prove useful he affects the outcome of

the debate. He thus aids one group at the expense of others. However dispassionate he might be, however disinterested in the outcome, insofar as he informs the debate he fosters one set of distributional consequences over potential others. This is to say, every technical analysis is inherently political in character."

This is a far cry from the lofty concept of the transportation planner as a grand social accountant who, with the help of a benefit/cost balance sheet, determines what is "in the best public interest." But it is a role which the planner must be prepared increasingly to assume and which, in the end, is perhaps the only useful role he can play in this diverse and pluralistic society of ours.

The Revolt Against Unconstrained Growth

Historically, transportation planning has been based largely on stimulation or accommodation of transportation demand. The need for new transportation facilities often would be justified by extrapolating prevailing trends in the growth of traffic and by equating these projections with future transportation demand. New facilities built in anticipation of this demand then inevitably attracted additional users, quickly became saturated, and thus provided justification for yet another round of expansion.

This orientation, dominated by a narrow conception of transportation demand, was justified in the days when an expanding transportation system was necessary to fuel economic growth. Today, in a more mature economy, this approach may no longer be consonant with our needs.

In a brilliant essay, "Energie et Equite," published a few months ago, Ivan Illich argues that transportation, far from giving man increased freedom, has in fact enslaved him through "enforced mobility." He pleads for a new era of technological maturity in which society would come to dominate transportation rather than be dominated by it.

With Illich and other observers I am inclined to believe that our drive for ever-rising speed and mobility is being sustained at a growing social cost. Each addition to the capacity of the transportation system, each increase in speed, adds to the strain on energy resources, takes away valuable land, increases the burden of pollution and noise, and introduces additional disturbance into people's lives. Until recently these costs were deemed an acceptable price to pay for the vast economic, social, and personal benefits derived from transportation investment—and so the growth of transportation facilities was constrained only by the ability to pay. Today this attitude is changing. In a large number of cities on both sides of the Atlantic, plans to build or expand highways have collapsed under the pressure of citizen protest or else are hopelessly mired in legal or administrative entanglements. Plans for new airports meet with increasingly vocal opposition from local communities, forcing airport authorities to look for sites at a growing distance from metropolitan areas. Even mass transit proposals have met with public opposition on social and environmental grounds. Citizens of Zurich, for instance, voted down a proposition to equip the city with an extensive network of underground lines. Similar debate is under way in Amsterdam.

These initiatives call attention to the rapid shift in public attitudes. They reflect a rising recognition of the adverse consequences of unconstrained growth and a new will to control and channel the forces of growth. They are part of the same mood that has caused Sweden and Japan to deflect further industrial expansion and urbanization in some parts of the country and that has made many communities in the United States enact measures intended to freeze or restrain further development.

We would be ill advised to ignore these trends or to dismiss them as a passing fad. They represent a fundamental shift in attitudes and values; they signal the onset of what William Ruckelshaus has called "an environmental civilization" in which the relentless emphasis on growth rates will be tempered by a growing concern for the fragile environment, by a new deference to the limits to natural resources, and by a selfish desire to improve the quality of our own lives.

For transportation planning, this new climate of opinion has two important implications. The first is that the null alternative—the option of not doing anything—deserves to be given equal weight with other alternatives. Supporting data for the null alternative should be developed to a level of detail consistent with that for other choices so that the option of doing nothing can serve as a reference point for comparing the adverse and beneficial effects of other proposals.

The second implication is that sometimes it will be preferable to think small rather than big: to concentrate on making the best use possible of what we already have, rather than always relying on new facilities for meeting future transport needs.

The situation confronting us in the field of airport planning illustrates the point. The traditional response of airport authorities to the seemingly insatiable appetite for air transport service has been to plan bigger airport complexes. When acceptable sites to accommodate such airports could no longer be found within easy reach of the cities, the response has been to go further away. But the basic premise—the need for a new airport—hardly ever has been questioned. This is now changing. In metropolitan regions where sites for new aiports can no longer be found, airport authorities are learning to manage better and to increase the capacity of existing facilities. In addition to building parallel runways and expanding terminal capacity, they are exploring such alternatives as decentralizing airport operations by shifting certain operations to secondary airports, imposing operation quotas on airlines, encouraging the use of high-capacity aircraft create conditions for entirely new concepts in air throughout the day. These and similar measures may give airports the respite they need until technological breakthroughs in the development of quiet, more flexible aircraft create conditions for entirely new concepts in air service to take the pressure off the existing large airports.

To summarize, two central issues will dominate transportation policy in the years ahead. The first is equity: Who pays for and who benefits from transportation development? How are the competing interests of the various groups to be reconciled? How can an effective community consensus be reached on a course of action that is workable, fair, and desirable? The other issue is transportation growth: What yardstick are we to use to assess future transportation demand? How can we strike a balance between the public demand for ever-greater mobility and convenience and the twin constraints of diminishing resources and environmental protection?

How sensitively the transportation and planning professions respond to these issues may determine whether they retain the confidence of the public and continue to play a constructive role in the shaping of public decisions about transportation. □

Universal office products
Report Binder

T35 BRA2
Boston Redevelopment Autho.
Central Artery feasibility
study.
ity

DATE	ISSUED TO